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The Journal of

Personnel Research

Vol. III Nos. 10 and 11
February-March
1925

Official Publication of
Personnel Research Federation

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Published Monthly
Williams & Wilkins Company
Mount Royal and Guilford Avenues
Baltimore, U. S. A.

Made in United States of America

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Price per volume, net, postpaid, $5.00, United States, Canada, Mexico, Cuba; $5.50, other countries.

Entered as second-class matter May 20, 1922, at the post office at Baltimore, Maryland, under the act of March 3, 1879.

† Deceased

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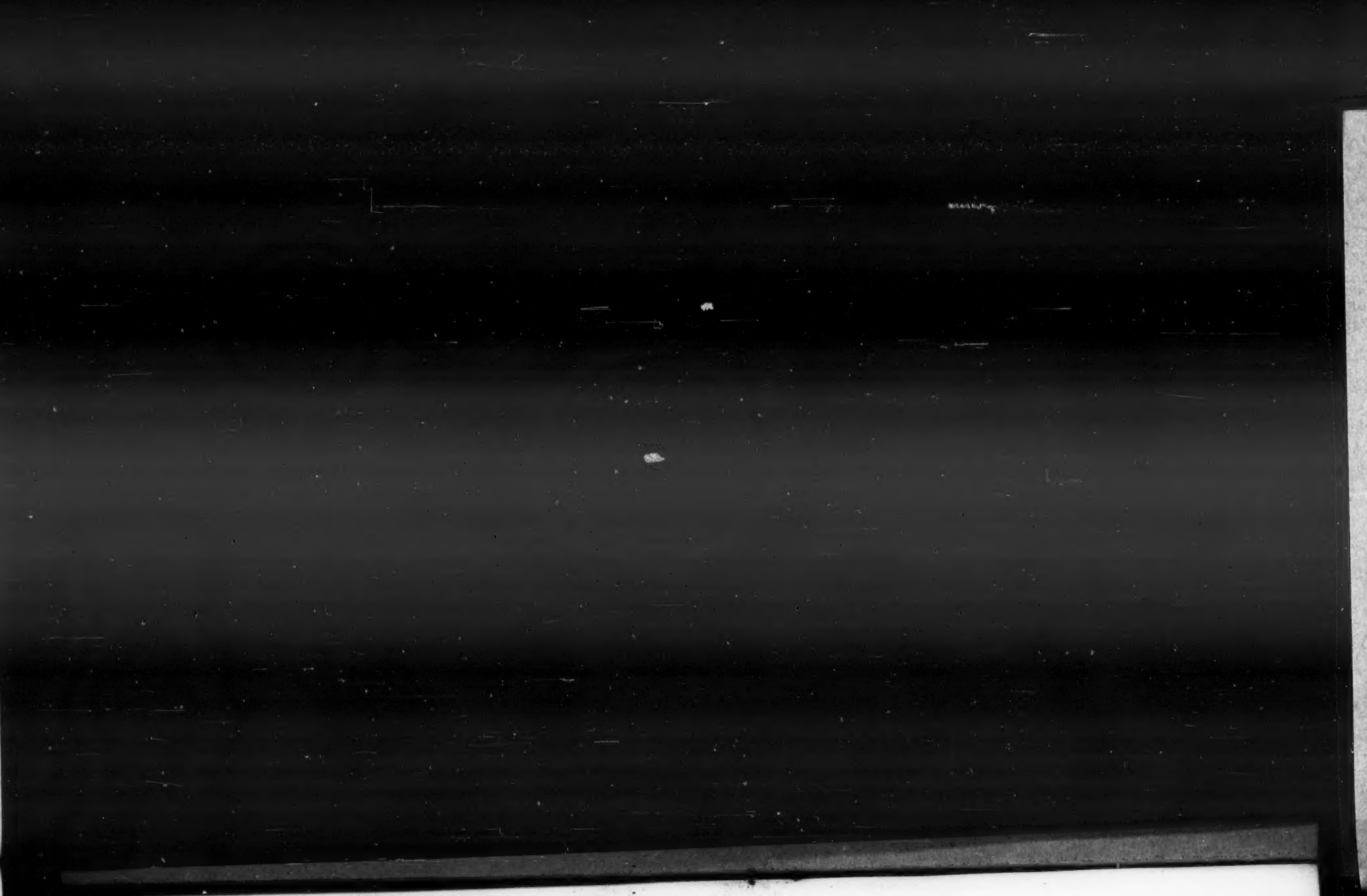

An Index for Predicting Labor Turnover

By Eugene J. Benge, *Manager of Industrial Relations, The Atlantic Refining Company*

"A weather vane which will show the way the labor winds are blowing, before a gale sweeps valuable employees past your pay-off window" is described in this study by Mr. Benge. The index may be used as a warning of approaching employment needs.

EVERY employment manager is naturally interested in keeping in touch with "the labor situation." Personally, the writer has never been able to find out what this "labor situation" means, although he usually knows all too well when applicants are scarce.

Several indices are in use to point out conditions in a local labor market. One of these is the number of Help Wanted ads appearing in the daily newspapers—when this number increases, men are harder to get: the labor market is tight.

This index is valuable, but very general. It is a known fact that some industries are dull at the time that others are running to capacity. If these two factors counterbalance, the newspapers might fail to register any change. Then, too, the fact that men are available is no indication that *your* company will get its share—perhaps your rates are low, your working conditions poor, transportation facilities inadequate or the company reputation may be bad. The voluntary turnover figure is usually a good index of the reaction of employees to the company, and a reflection of outside labor conditions—but it is a post mortem.

What is needed is some weather vane which will show the way the labor winds are blowing before a gale sweeps valuable employees past your pay-off window and applicants away from your employment office. Such an indication should show the reaction of outside labor conditions on your company.

For some years the Industrial Relations Department of this company has compiled careful statistics of labor conditions. Recently many of these were plotted in graphic form, affording some very interesting studies. The charts include the following:

1. A percentage comparison of cost of living in Philadelphia with wages and salaries, all based on 1913.

2. A comparison of salary roll conditions in number of employees and average salary, with labor turnover (of the salary roll), from 1918 to date.

3. A comparison of *plant* labor conditions (monthly averages) as shown by

a. Number of men on the payroll.

b. Average working.

c. Absenteeism (in per cent).

d. Labor turnover (in per cent).

e. Average wage (in dollars).

f. Lateness per 1000 employees.

4. A comparison of the labor turnover curves of our five main plants (in per cent).

5. The per cent of applicants accepted for employment who fail to start work.

The last named chart is used as a valuable "weather vane." To understand why this should be it is necessary to comprehend the particular employment system in use at this company.

When an applicant enters the employment office he is directed to an interviewer who discusses with him the possibilities of employment. If the applicant is acceptable the interviewer fills out an application form for him and then sends him to the file clerk. The file clerk searches for any previous record in our files to discover whether there is any notation in his previous record which would argue against his reemployment. If the applicant has had no previous service with the company or if his previous record has been good, he is passed on to the doctor for a medical examination. Should the doctor pass the applicant, specific directions are given him stating when and where to report.

Each month we find that a certain per cent of applicants who have passed through our employment system either fail to report for work or fail to start work when taken to the job. The actual number of men monthly is given in table 1. For several years we have followed the percentage figure with interest, believing that it expresses an intangible attitude of labor, reflecting conditions in the outside labor market. From time to time we have compared the curve showing the percentage of applicants who fail to start work monthly with other labor curves, and have occasionally found interesting concomitant variations. Working on the theory that the same condition of the labor market which causes applicants to relinquish possible jobs will, somewhat later, overcome the inertia of many of our employees and so increase our labor turnover, we recently made an intensive study of this index.

We first correlated the percentage of applicants who failed to start work with the total labor turnover percentage for the same month and also for the following month. The correlation

TABLE 1

Number of men accepted who failed to start work monthly

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1920	116	143	100	102	50	82	165	151	114	145	148	22
1921	2	4	1	2	0	11	2	26	8	38	65	104
1922	39	20	10	50	90	109	128	119	81	89	92	99
1923	121	73	110	143	94	158	157	63	56	78	38	7
1924	25	11	14	14	20	7	1	1	6			

TABLE 2

Comparison of per cent of applicants accepted who failed to start work with per cent of voluntary turnover, 1920 to 1924

	1920		1921		1922		1923		1924	
	Applicants	Voluntary turnover	Applicants	Voluntary turnover	Applicants	Voluntary turnover	Applicants	Voluntary turnover	Applicants	Voluntary turnover
January	16.0	6.3	1.0	2.7	7.3	7.3	13.8	11.0	3.8	4.9
February	19.0	8.2	3.5	1.7	7.0*	6.8	12.9	11.2	4.6	3.5
March	13.0	9.8	1.5	2.3	6.0	6.3	16.2	11.9	3.0	4.2
April	17.0	13.1	0.9	3.0	6.3	8.6	16.0	14.9	3.8	5.3
May	15.0	13.5	0.	1.4	10.2	11.8	9.1	11.0	6.1	5.8
June	16.0	8.5	5.0	3.5	12.0	14.3	11.2	15.6	7.7	3.9
July	17.0	8.6	5.8	2.3	14.1	17.3	11.1	15.9	1.4	2.7
August	20.0	12.6	6.7	1.4	14.2	15.5	10.7	11.2	2.0	2.1
September	13.0	9.7	4.1	4.8	10.4	13.6	6.9	10.9	1.7	2.9
October	12.0	10.2	5.6	5.4	10.0	12.1	8.0	10.3		
November	12.0	7.3	7.5	5.2	14.0	11.3	9.3	10.5		
December	10.0	4.3	7.8	7.4	15.8	9.7	3.1	5.9		

TABLE 3

Per cent of applicants accepted who failed to start work compared with per cent of voluntary turnover (both smoothed by twelve months moving averages)

	1920		1921		1922		1923		1924	
	Applicants	Voluntary turnover	Applicants	Voluntary turnover	Applicants	Voluntary turnover	Applicants	Voluntary turnover	Applicants	Voluntary turnover
January			13.8	9.0	4.6	3.8	11.2	11.5	9.9	11.2
February			12.5	8.5	4.9	4.2	11.6	11.9	9.2	10.5
March			11.5	7.9	5.3	4.6	12.5	12.4	8.1	9.8
April			10.2	7.0	5.8	5.0	13.3	12.9	7.1	9.1
May			8.9	6.0	6.6	5.9	13.2	12.8	6.8	8.7
June			8.0	5.6	7.2	6.8	13.1	12.9	6.5	7.7
July			7.1	5.1	7.9	8.0	12.9	12.8	5.5	6.9
August			6.0	4.2	8.5	9.2	12.6	12.4	4.7	6.0
September			5.2	3.7	9.0	10.0	12.3	12.2	3.8	5.2
October			4.6	3.3	9.4	10.5	12.1	12.1		
November			4.3	3.2	9.9	11.0	11.7	12.0		
December	15.0	9.3	4.1	3.4	10.6	11.2	10.6	11.7		

coefficients were about plus 0.50, not high enough to be used for predictive purposes.

We next correlated this percentage with *voluntary* turnover, (computed after excluding discharges and lay offs). We were led to work out this correlation by the close conformity of the two curves when plotted as shown in figure 1. But these two curves represent conditions in identical months whereas we desired to correlate the percentage of applicants who failed to start work in any particular month with the voluntary turnover the following month. Using the data from table 2 we correlated January applicants with February turnover, February with March, March with April, etc., and secured a coefficient of r = plus 0.667. This was sufficiently higher than the previous correlations to be encouraging so we attempted to eliminate seasonal fluctuations by computing the twelve months' moving averages. (See table 3.)

When the data of table 3 were plotted on a scatter diagram, as shown in figure 2, a very peculiar condition was revealed. Figure 3 shows the same condition by a comparison of the two curves. From both the scatter diagram and the curve comparison, it is evident that there was considerable disparity between the two variables (twelve months' moving average) in 1921. If we draw in two regression lines in figure 2, we find two different conditions. If we eliminate from figure 2 the first 13 dots plotted from table 3, and correlate the remainder, we secure a correlation of plus 0.9, which is quite high. It is, of course, a well known fact that one can secure a high correlation by smoothing the variables (and this smoothing is accomplished by the moving average). However, with this as a lead, we analyzed the cause behind the regression line in figure 2, whose equation is $x = 0.6\,y - 0.4$. We found that it was due in great part to the chaotic conditions

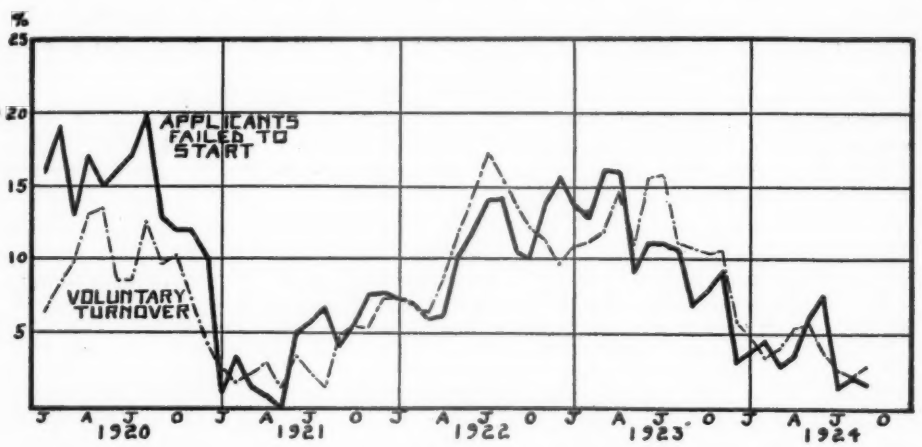

FIG. 1. PERCENTAGE COMPARISON OF APPLICANTS WHO FAILED TO START WORK, WITH VOLUNTARY TURNOVER

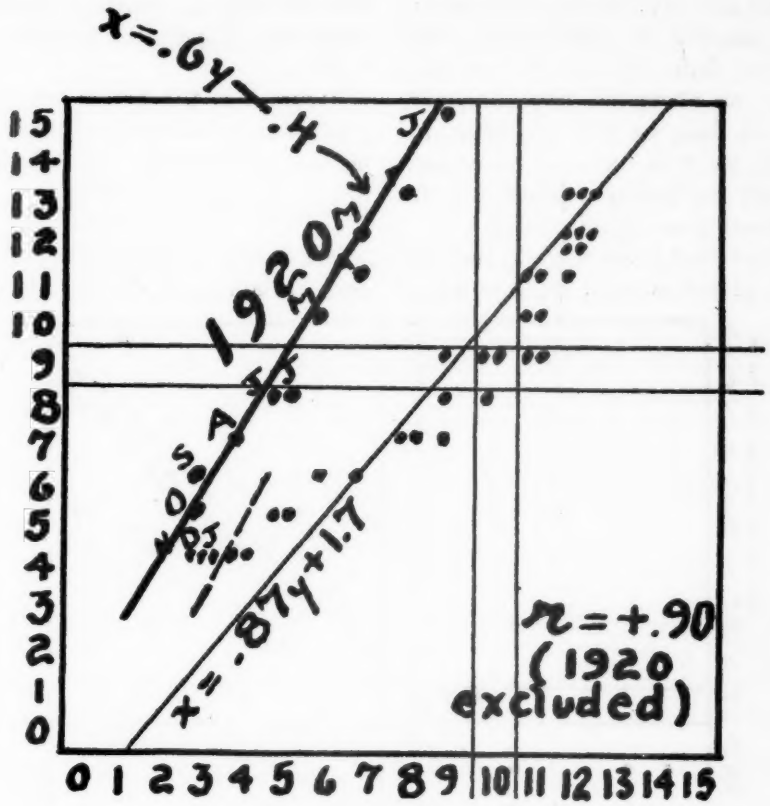

FIG. 2. SCATTER DIAGRAM
Data from table 3. Note the different scatter in 1920

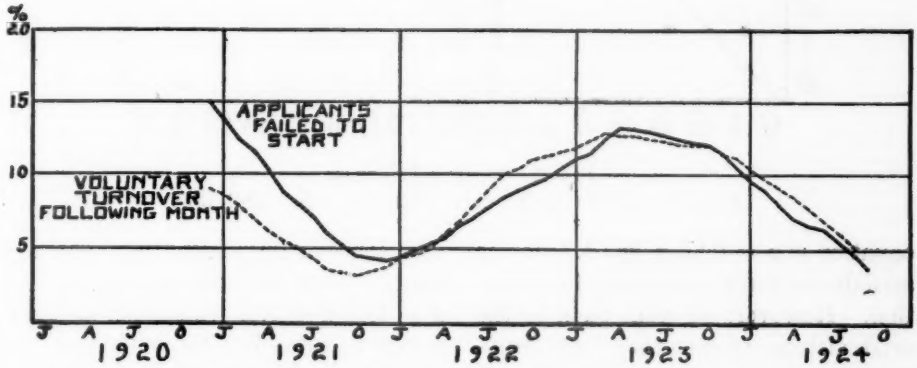

FIG. 3. PERCENTAGE COMPARISON OF APPLICANTS ACCEPTED WHO FAILED TO START WORK, WITH VOLUNTARY TURNOVER FOLLOWING MONTH
Both curves smoothed by using twelve months moving averages

in *1920* and accordingly felt that we were justified in eliminating 1920 from our data. We believe that conditions as expressed from January, 1921, to date are still prevalent, although we will have to recalculate annually the final correlation and the regression given in this article.

It is evident from figure 2, that the points plotted around the line whose equation is $x = 0.87\ y$ plus 1.7, do not actually conform to a straight line equation. However, we went back to the original data, not smoothed, from January, 1921, to June, 1924 (table 2), and correlated the percentage of applicants who failed to start work in any given month with the percentage of voluntary turnover the following month, and secured a Pearson correlation coefficient of plus 0.809 ($PE_r = \pm 0.036$).

Figure 4 is the actual scatter diagram from which the plus 0.809 correlation was obtained. By substituting in formula $x\text{-}M_x = r\frac{\text{Sigma}_x}{\text{Sigma}_y}(y - M_y)$, where x and y represent points on each variable, and M_x and M_y (the respective means) points were obtained for the plotting of the regression line $x = 1.01\ y + 0.2$. Inasmuch as there would be no object in computing the percentage of applicants who failed to start work in any *previous* month, the other regression line was not drawn in.

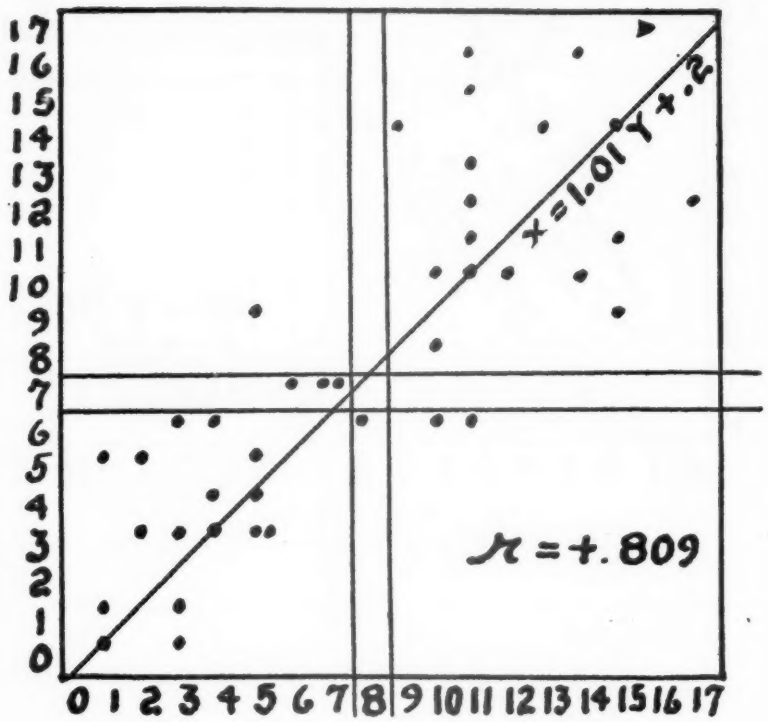

FIG. 4. SCATTER DIAGRAM
Data from table 2, January, 1921, to June, 1924, only.

As a result of this entire study we have prepared table 4 which enables

us to predict the voluntary turnover of the coming month when the percentage of applicants who fail to start work in the current month is known.

TABLE 4

PERCENTAGE OF APPLICANTS ACCEPTED WHO FAIL TO START WORK	PREDICTED PERCENTAGE VOLUNTARY TURNOVER THE FOLLOWING MONTH
0	0.2
1	1.21
2	2.22
3	3.23
4	4.24
5	5.25
6	6.26
7	7.27
8	8.28
9	9.29
10	10.30
11	11.31
12	12.32
13	13.33
14	14.34
15	15.35
16	16.36
17	17.37

By presenting this and other labor indices at our biweekly meeting of superintendents, we keep the supervisory force of the plant informed as to labor conditions. They are thus warned to take precautions against losing good men. From the viewpoint of our own department, the storm signals warn us to trim our sails close to the labor winds. We accordingly take means to secure more applicants as well as intensify our efforts to utilize our present working force.

At the time this article was first prepared, data to and including June, 1924, were available. Since then the writer has had opportunity to add figures for three months more to the tables and curves.

When another year has gone by we expect to check up again on this entire study, both to note the accuracy of the monthly predictions and to change the regression formula if necessary.

The Preference-Interest Questionnaire in Selecting Retail Saleswomen

By DAVID R. CRAIG,[1] *Research Bureau for Retail Training, University of Pittsburgh*

A short-cut to the prediction of retail sales ability would be worth enormous sums to American business. Such a short-cut has not been found, nor will it be discovered until some painstaking and brilliant investigator is willing to make a more thorough study than has yet been attempted of the components of sales ability, the traits which distinguish good and poor sales people, and typical behavior which marks the presence or absence of those traits. Professor Craig clears the ground in several important regards. He reveals certain limitations of tests and questionnaires as aids in prediction. He describes in a most helpful way those practical considerations of store practice with which experimenters must reckon if they are to be certain of getting dependable data and reliable criteria of sales ability against which to check the validity of proposed aids in selection.

UNLESS negative results in an experiment of personnel research yield a basis for affirmative conclusions or throw light on points of method, there is no excuse for recording them in print. This paper describes an experiment which failed; the sanction for its chronicle is found in the incidental conclusions which were brought to light.

[1] This investigation was accomplished largely by others than the writer. It is reported by him because he alone participated in all three parts of it. In the Kaufmann study the examiners were Dr. L. L. Thurstone, Miss Thelma Gwinn, Miss Natalie Kneeland, Miss Julia Mockett, and Mr. Martin Mundorf. In the first Macy study the examiners were Miss Josephine R. Glascock and Miss Marjorie S. Choate, of the staff of the R. H. Macy Company, and Miss Ada Terrill. The second Macy study was conducted by Miss Glascock, Miss Choate, and the writer.

HOW SALESWOMEN ARE SELECTED

The problem which the experiment attacked was the selection of saleswomen in department stores. Today saleswomen are selected largely by giving them a trial and eliminating them if they fail. To be sure, a few preliminary questions concerning experience are asked, which permit the interviewer to refer to previous employers and determine the applicants' honesty; and candidates who are obviously stupid or slovenly, or too old or too young, are

rejected without employment. But the larger portion of applicants are acceptable in respect of personal appearance and honesty, and when positions are open they are employed—in complete ignorance of their ability to sell merchandise. No employment manager of the writer's acquaintance seriously believes that he can tell a good saleswoman from a poor one without giving her a trial at the counter. He can say of a given candidate only that she may (or may not) turn out well. As a consequence many costly mistakes are made: mistakes which managers are not always quick to recognize because their accounting departments cannot disentangle that portion of overhead costs for which these mistakes are responsible. The aim of this study, then, was to see whether good saleswomen have any discoverable attributes which are lacking in unsuccessful saleswomen.

BEGINNINGS OF THE RESEARCH

A preliminary and exploratory study was conducted with the cooperation of the Kaufmann Department Stores, Inc., at Pittsburgh. Employment supervisors and department managers in consultation selected a group of 25 saleswomen between the ages of eighteen and thirty whom they rated "good," and another group of 25 whom they rated "poor." Four persons dropped out of the latter group during the testing, which spread over a period of three months, so that only 46 took the entire series. Thirty-one tests of widely different types were included in the series; five of these were questionnaires of interests and preferences, and with one or two exceptions, such as the Kent-Rosanoff free association test, the rest were tests of some ability. The tests of ability were scored by noting the number of items in each test accomplished correctly, and the number omitted. The questionnaires were scored by a rough method which eliminated questions answered by both groups in the same way; gave a value of +1 to answers characteristic of the good group but not of the poor group; and gave a value of −1 to answers given predominantly by the poor group but not by the good. No criterion of predominance other than the inspection of tabulated answers was used.

The tests of ability all failed to distinguish between good and poor saleswomen.[2] But a set of questions

[2] The unsuccessful tests are listed and briefly described below:

1. *Judgment in Selling.* Ten selling situations are given in question form, with four possible ways of meeting each situation. The subject indicates her preference among the possible answers.
2. *Will-Temperament.* (*Bureau IX*). The Downey Test, modified by the Bureau of Personnel Research.
3. *Bureau Test VI.* A spiral-omnibus intelligence test in which several parts of the Army Alpha Test have been combined, by the Bureau of Personnel Research.
4, 5, 6. *Macy tests.* Tests originally developed at R. H. Macy & Co., New York City, to distinguish between individuals with selling ability and those with clerical ability.

selected from the questionnaires was found significant for the purpose. By totalling the scores made on these questions a range of scores from −17 to +20 was found; and by drawing a critical score between −1 and −2, all but three members of the poor group were eliminated and all but two of the good group selected. That is, all but five out of 46 were properly placed, an 89 percent selection.

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7. *Macy Test T-1-A.* A simple sentence-completion intelligence test, the content referring particularly to department store material.
8. *Absurdities.* A test of ability to distinguish between logically possible and absurd statements.
9. *Range of Interest.* (Bureau V). A test to determine the range of information on general topics possessed by the subject, by the Bureau of Personnel Research.
10. *Meeting Objections.* A test in which the examiner presents buying objections and rates the subject on her manner of meeting them.
11. *Sequence.* A test of ability to rearrange in their original order twelve disarranged drawings which were published as a comic supplement of a Sunday newspaper.
12. *Tempo.* A test of the subject's ability to tap with a pencil on a table evenly and regularly over a certain period of time.
13. *Directions.* A test of the subject's ability to follow simple directions.
14. *Knox Cube.* A test in which the task of the subject is to imitate the examiner in tapping four cubes in an increasingly complicated order.
15. *Color-naming.* A test to determine ability in naming correctly and rapidly a number of differently colored squares printed on a card.
16. *Hand Test.* A spatial relations test to determine the subject's ability to tell right hands from left hands, given a series of pictures of hands in different positions.
17. *Clock Test.* A spatial relations test in which the subject's task is to compute the time of day if the hands of the clock were interchanged at given times.
18. *Block counting.* A spatial relations test to determine ability to count the number of blocks in pictures of sets of blocks.
19. *North and South.* A spatial relations test of ability to translate the directions given in terms of the points of the compass into directions in terms of right and left.
20. *Müller-Lyer Illusion.* A test to determine the subject's degree of susceptibility to an optical illusion.
21. *Size-weight Illusion.* A test to determine the subject's degree of susceptibility to the suggestion that a smaller object is lighter than a similar-appearing larger one.
22. *Judgment on Insufficient Data.* A test of the subject's ability to pick out the predominant character in a line of disarranged characters.
23. *Pencil Maze.* A simple maze test, in which the subject is required to trace a line from one end of a diagram to the other.
24. *Word-Building.* A test of the subject's ability to write several words made up from a given series of letters.
25. *Kent-Rosanoff Association Test.* A test of controlled association, in which the score is the number of responses given, the number of "baulks" and the commonality of the responses.
26. *Free Association.* (Bureau XIIB). A free association test, starting with a given stimulus word.

All of these tests were found to be useless in distinguishing between the good and the poor salespeople. One or two of them gave positive results, but were rejected because of difficulty in administration or scoring.

Ten questions may be quoted to show the nature of the questionnaire:

1. Are you easy to get acquainted with?
2. Can you easily get the crowd to go the way you want them to go?
3. Do you frequently get depressed about your work?
4. Do you think you would enjoy riding in an aeroplane?
5. Do you feel even more sure of yourself when some one contradicts you?
6. Do you like to do mechanical work requiring little thought?
7. Do you like to work where you don't have to talk?
8. Do you like to play checkers?
9. Do you like having people watch you work?
10. Do you like letting people do things for you?

The encouraging result of this preliminary study was, of course, not conclusive. Only a small number of subjects had participated; the investigators had reason to believe that the method by which the good and poor groups had been selected was not altogether satisfactory, and the method of scoring the questionnaires, having no objective criterion by which the predominance of the answers by good and poor groups could be judged, was inexact. But the result indicated that a hopeful approach to the problem had been found, and it was decided to base further experimentation on the preference-interest questionnaires alone. The other tests were eliminated from further consideration in this study, and were reserved for another trial in case of failure with the questionnaires. This decision was supported by the success about this time of Ream[3] and Freyd[4] in their use of questionnaires (in combination with tests), applied to the selection of other occupational groups.

EVALUATION OF THE INTEREST QUESTIONNAIRE

The second experiment was conducted at the store of R. H. Macy & Company, in New York City. A more precise selection of subjects was made possible by the excellent manner in which the sales records were kept. Each week the names of the members of non-station[5] departments were arranged in the order of the value of their sales, and lines were drawn to mark off the highest quarter (called "above average"), the middle half (called "average") and the lowest quarter (called "below average"). From the list so marked the position of each employee was recorded on her permanent record card. This plan[6] permitted

[3] Ream, M. J. Ability to Sell, Its Relation to Certain Aspects of Personality and Experience. 1924, pp. 38, 39, 50, 51. Baltimore: Williams & Wilkins.

[4] Freyd, M. A method for the study of vocational interests. Journal of Applied Psychology, 1922, vi, 243–254.

[5] Non-station departments are those in which the salespeople are not restricted to particular sections, with goods of only one price level, but are assigned at large to the whole department and may sell any merchandise which it offers. The importance of choosing only from such departments is that the sales records are comparable. In a "station" department, those who are assigned to the cheaper merchandise may not be compared with those who sell the dearer.

[6] Miss Glascock devised and executed the scheme.

the selection of good and poor saleswomen in a more satisfactory manner. "Good" salespeople were defined as those who had been marked "above average" for eight weeks out of twelve; "poor" salespeople were defined as those who had fallen in the "below average" division for eight weeks out of twelve. So arranged, it was possible to state the sales records in quantitative form. A value of 5 was given, arbitrarily, to each saleswoman for each week in which she ranked "above average"; a value of 3 for each "average" week; and a value of 1 for each "below average" week. Persons on the borderline between these divisions were given values of 4 and 2 respectively. To secure the quantitative sales record of the individual it was necessary only to add the values for her successive weeks.

Sixty-three subjects were selected in this way, including a group midway between the successful and the unsuccessful. The good group and the average group contained 25 saleswomen each; the poor group contained only 13, for persons who demonstrate the consistent inferiority required for admission to this group are seldom retained for twelve weeks in a well-managed store like Macy's, and are hard to find. The five questionnaires were given to these subjects, including the questions which had not been found significant in the Kaufmann study. They were scored by the statistically defensible procedure applied to this class of problem by Freyd.[7]

There were three results from this experiment. First, the scoring method worked out during the Kaufmann study would not differentiate the good saleswomen from the poor ones at Macy's; that is, the questions which had been successful in Pittsburgh were unsuccessful in New York. Second, by scoring the papers again with the new scoring method evolved out of the Macy study, it was possible to distinguish the Macy groups with unexpected success, yielding a Pearson correlation coefficient of +.76 between test scores and the quantitative sales records. But third, the new scoring method, turned back on the Kaufmann subjects, refused to distinguish between them at all. Thus neither scoring method would successfully differentiate good and poor salespeople other than those on whose answers it was based.

It was a disappointing conclusion, but the failure of this approach was not yet certainly indicated. A geographical difference in the characteristics of good and poor saleswomen as between Pittsburgh and New York, or the fact that the two studies had been conducted by different examiners under different circumstances, might have contributed to the negative findings. It was decided to repeat the Macy experiment under precisely the same circumstances. If this should result in failure, the result would be conclusive. If it should succeed, the examiners would be justified in continuing the use of the preference-interest questionnaire in further investigations until satisfactory standards could be established.

[7] *Op. cit.*

Using the same criterion of selection as in the second experiment, 71 saleswomen were chosen. An average group was again included. The questions given were those which had been successful in distinguishing between the groups participating in the second experiment. They were given in the same room, by the same examiners. The scoring method evolved from the second experiment was repeated.

The results were completely negative. The Pearson coefficient of correlation between test scores and selling records was +.034, a negligible correspondence.

This finding is substantiated by conclusions which Miss Glascock reached in an independent experiment. Her questions were of much the same character, and her scoring had been evolved in the same way. In a previous investigation she had arrived at a list of questions which distinguished quite well between good and poor saleswomen. This list, given to new subjects, yielded a coefficient of +.163, a slightly greater but still meaningless relationship between test scores and sales records. Not only that; in another study Miss Glascock found that saleswomen who answered these questions could not be relied on to answer them the same way a year later.

One avenue of escape from the conclusion that these results indicate a conclusive failure was opened by the suggestion of Dr. Freyd that the reliability of the sales record as a criterion for selecting the subjects be examined statistically. There are some logical reasons for questioning it. The chance exists that saleswomen rated as "above average" in busy months are not much abler than saleswomen rated "below average" in dull months. For example, the saleswoman who ranks barely "above average" in a department swollen by the demands of a busy season will fare badly at the hands of the rank method when the saleswomen of less ability than herself are released at the beginning of the dull season. She might rank third in a department of twelve in December, and still rank third in a department of three in February. The records on which the two Macy studies were based covered the months of August and September, 1922, and the months of April, May and June 1923. August is a dull month, with a slight revival toward the latter part of September. April, May and June constitute the minor peak of the year, and are exceeded only by the Christmas rush.

The records of 24 employees were available over both periods. A comparison was made to see whether they maintained their relative positions, and the resulting rank-difference coefficient was +.79. This is high enough to warrant rejecting the supposition that a seasonal influence entered significantly into the selection of the subjects.

WHY THIS SELECTION METHOD DOES NOT WORK

This closes the avenue of escape, and the failure may now be considered definite. One falls back on

speculation in searching for causes, and finds three hypotheses which may be advanced in partial explanation.

The first of these is obvious: if one cannot discover any personal preferences and interests which are characteristic of good saleswomen but not of poor ones, it may be that salesmanship is independent of preferences and interests. Personal characteristics of this sort are largely determined by the social environment of their possessors, and unless the social status of successful saleswomen is discernibly different from that of poor saleswomen it is idle to rely on preference-interest questionnaires for the desired distinction. If this is so, the peculiarities of saleswomen can be discovered only by approaching them from a different angle.

A second hypothesis might hold that a mistake has been made in assuming salesmanship to be a general trait, i.e., that a good salesperson can sell anything well. It may be that the group was a heterogeneous group after all, and that a more promising attack would have selected as subjects the members of a single department. It is conceiyable, for example, that good saleswomen in a ready-to-wear department have preferences and interests different from those of the poor saleswomen in the same department, but similar to those of the poor saleswomen in a yard-goods department, or *vice versa*. Acceptance of this hypothesis turns the question into a problem of placement rather than of selection, and it also renders investigation exceedingly difficult unless several stores can be induced to coöperate; for the membership of single departments is too small to yield significant results.

The third explanation lies in the reaction of the individual subject toward the questions. Taken from her customary work to a strange office, the saleswoman may have difficulty in answering the questions thoughtfully and honestly, no matter how careful the examiner may be to put her at her ease and to explain the purpose of the questionnaire. She will realize that she is missing a chance to earn the commissions on her sales during the period of her absence. And the questions have no relation to her work: they are "fool" questions to her, and if she hears the word *test* she may become hostile, thinking her "sanity" is at issue. She will more likely give the answers which she feels she ought to give than those which she first hits upon.[8] If this explanation is accepted, it means that no questionnaire of the type used can possibly make the desired distinction. It is no answer to say that all the subjects will react alike to the testing; nor is it quite accurate. But it is a partial answer to say that the questionnaire has been successful with other occupational groups.

Thus there is the chance that the investigation was following a false trail in assuming that all good saleswomen have some preferences and interests in common. It may have

[8] Miss Kneeland, during the Kaufmann study, found the Kent-Rosanoff free association test especially difficult in this connection.

been at fault in not restricting its scope to the study of saleswomen in a single department rather than in a whole store. Or it may have been wrong in expecting thoughtful and honest answers from hurried and sometimes suspicious subjects. Since there are no materials at hand with which these hypotheses can be tested they must be left for subsequent investigators. This paper can be concluded by noticing a few aspects of psychological work in department stores which arise out of the experience of the present investigation and out of the ashes of its failure.

LESSONS OF THE EXPERIMENT

In selecting subjects for any study which involves salespeople it is unwise to rely on the opinion of the department manager (usually the buyer) or the employment supervisor. Such opinions may be colored by personal prejudice, but more commonly they are haphazard. The buyer and the employment supervisor often disagree. Furthermore, not even in department store circles has salesmanship been adequately and uniformly defined. In a store of one type the sales record is the only measuring stick; in another store considerable emphasis will be placed upon "selling the store" rather than upon "selling the goods," and here courtesy is a stronger element of the local business morality than the sales book. But in general it is possible to persuade the department manager to wink at occasional overeagerness in a salesperson who shows a consistently good record in value of sales. The objective sales record constitutes a more satisfactory criterion than executive opinion. It is more susceptible of quantitative treatment, and it is more precise.

The sales record must be carefully managed. If persons from more than one department participate in the investigation, it is necessary to allow for the differently priced goods which they sell. A saleswoman in a ready-to-wear department can sell as many dollars worth in an hour as a notions saleswoman can dispose of in a day. The method of record-keeping developed at Macy's, described above, makes the necessary compensations. Another expedient is to compute the ratio of the individual's sales to the average sales in her department.

The point of choosing subjects only from non-station departments has already been explained.[9] It should not be overlooked in a testing program.

In preparing a time schedule for a store experiment it will be useful to remember certain features of a retail business. The department store has two peaks of activity during the year, one in May and June, the other in November and December. The best time for installing a series of tests for experimental purposes is at the end of the busy season, before the dull season has begun in earnest. During the peaks the personnel office, through which the investigator will presumably work, is as rushed as the merchandise departments, and it is difficult to gain the

[9] *Supra*, note 5.

optimum coöperation at such times; in addition, buyers and floor managers are reluctant to release their assistants to experimenters in these months even for a half-hour. In the dull seasons many employees are laid off, and the investigator who wishes to study poor salespeople as well as successful ones will have trouble finding many of them. If he can arrange his study so that it does not conflict with the peaks, and yet begin it before many employees have been laid off, he will obviate these two difficulties. It is also wise to administer the program to the inferior salespeople first, and to select more of this type than of good salespeople, because the better employees are more securely attached to the store.

No peaks occur from week to week, but inside the weekly interval the heavy loads occur on Monday, Friday and Saturday. Tuesday, Wednesday, and Thursday are the best days for the experimenter.

The maximum burdens of the day come between 10:30 and 4:00 or 4:30. The experimenter will find it practically impossible to secure individual appointments during the middle hours of the day.

If the tests or questionnaires are to be given to groups, the experimenter will have to content himself with getting not more than one person from each department at a time. More than this constitutes a "raid," in the opinion of the section manager. Each group will therefore be small, and the test must be repeated with other groups, similarly composed of not more than one person from a section. Incidentally, it is desirable to notice in each case whether the person sent for is the one who appears, for now and then it will happen that a floor manager will send a poor salesperson instead of the good one requested, simply because the poor one is more easily spared.

Lastly, it is important to explain a testing program rather elaborately to any group of department store employees who are being requested to participate. To many persons a pyschological test is a test of "sanity," with the implication that the subject is unbalanced. The purpose of the test should be carefully set forth, and opportunity given for any to withhold their coöperation if they so desire. They should be assured that none of the store executives will ever see their papers, so that they need have no fear of being quite frank in their answers. Incentives to careful effort can be supplied by telling each small group that the test in question is being given to other groups, and that this group will surely wish to excel the others. But in order to hold constant as many factors as possible, the same explanation and the same incentive should be furnished to all the subjects alike.

These few cautions may lighten the burden of experimenters in stores, and may render it unnecessary for them to repeat the more obvious errors from which these lessons were learned.

Modern Ventilation Principles and their Application to Sedentary and Industrial Life[1]

By C. P. YAGLOGLOU, *Research Engineer, Amer. Soc. of Heating and Ventilating Engineers' Research Laboratories, Pittsburgh, Pa.*

The comfort of workers—in offices, laundries or foundries—is affected not only by the temperature and humidity of the air but also by the rate of air movement. The relation of these three variables and their control has been freshly and thoroughly investigated in the Research Laboratory of the American Society of Heating and Ventilating Engineers, in cooperation with the U. S. Bureau of Mines and the U. S. Public Health Service, at their Pittsburgh Experimentst ation. In this paper the theoretical values discovered are applied to industrial conditions as found in sedentary occupations, mines, steel mills and other industries.

I. The Relation of Temperature, Humidity and Air Movement to Human Comfort

THE vital importance of supplying buildings with fresh air at the proper temperature and humidity is becoming every day more generally recognized. Recent investigations have established the fact that temperature, moisture content, and movement of the air are the main requisites of efficient ventilation. The evil effects of crowded and badly ventilated places are not due to what a few years ago was called vitiated atmosphere, but are caused chiefly by the warmth and stillness of the atmosphere.

DETERMINING THE INDEX OF COMFORT

In the recent years of development in the art of heating and ventilation considerable difference of opinion existed in regard to what constitutes the best index of human comfort, or of discomfort arising from exposure to high temperatures.

Heberden, about a hundred years ago, realized the inadequacy of measuring comfort by any single instrument, such as dry bulb or wet bulb thermometer. No attempt, however, was made to determine the rela-

[1] Published by permission of the Director of the Research Laboratory, American Society of Heating and Ventilating Engineers, U. S. Bureau of Mines, Pittsburgh, Pa.

tive degree of importance to be attached to these temperature measurements.

Haldane (1904–1907) concluded that the discomfort experienced on exposure to high temperatures depends on the wet bulb temperature, irrespective of air temperature, humidity, or dew point.

Bruce (1916) contends that wet bulb temperature alone is not a measure of human comfort but the dew point rather than the wet bulb temperature constitutes such an index.

In view of this speculation and of the importance of the subject of comfort and efficiency, especially at high temperatures which constitute one of the most serious considerations in many of our industries, the Research Laboratory of the American Society of Heating and Ventilating Engineers, in cooperation with the United States Bureau of Mines and the United States Public Health Service, conducted exhaustive investigations, in which the relation of temperature, humidity and movement of the air to human comfort were definitely established. Concrete evidence thus far accumulated indicates that the human body does not entirely resemble a wet-bulb thermometer in its properties, nor does it resemble a dry bulb thermometer, but, for normal atmospheric conditions, it behaves in a manner midway between the two.

From our experiments, fundamental physical laws were deduced, the knowledge of which will enable the heating and ventilating engineer to make a scientific study of the problem involved, and apply these principles, either in producing an ideal condition or in improving existing unbearable conditions.

PRELIMINARY THEORETICAL CONSIDERATIONS

All life processes are accompanied by the generation of heat within the body, through the oxidation of the food substances that are taken in. In other words the human body resembles a combined unit of boiler and engine, in which heat energy is liberated, and transformed into mechanical energy through the medium of muscles. The greater the muscular activity the greater the heat produced in the body, which must be removed for life to exist.

If this heat is retained within the body, the subsequent rise of body temperature produces feelings of depression and discomfort, while death may occur within a comparatively short period of time. Under normal conditions the body maintains a temperature higher than the atmospheric environment, and it therefore loses heat to the surrounding air and objects. The constant temperature of the body indicates that the rate of heat loss is regulated, within limits, so as to be equal to the rate at which heat is produced.

Heat loss from the human body takes place in three different ways, namely; by radiation, convection, and evaporation. The body warms the surrounding objects and walls by radiation, in exactly the same manner as the sun warms the earth. The heated air in immediate contact with the surfaces of the body rises, due to its lower density, while cooler air takes its place, thus setting up con-

vectional currents which carry away part of the heat developed by the body. In addition the air evaporates moisture from the surfaces of the body, which is cooled by supplying the latent heat required by this process.

It follows that the physical condition of the atmosphere is the determining factor in heat loss, and therefore is of utmost importance to human comfort. If the temperature of the surrounding air is the same as that of the body there will be no heat removed by radiation or convection, and all of the heat produced within must be disposed of by the evaporation of perspiration. On the other hand, if the humidity is high, or when the atmosphere is saturated at a reasonably low temperature, little heat will be lost by evaporation, the greatest part being removed, in this case, by radiation and convection.

Humidity is the water vapor or moisture that is present in the air. This quantity varies considerably, depending largely upon the weather conditions. In conjunction with the two principle constituent gases of air, namely, oxygen and nitrogen, water vapor has a partial pressure of its own, and the sum of the partial pressures of the three gases is equal to the barometric pressure. For every temperature there is a partial pressure of the water vapor at which the air is in a saturated condition, that is, it contains the maximum amount of moisture that it can hold at that temperature. This saturation temperature is called the dew point. As the temperature increases the partial pressure of the saturated vapor increases also. If the temperature drops below the saturation point some of the vapor will condense and its pressure is reduced, according to the new temperature.

Absolute humidity is the amount of water vapor actually present in the air, expressed in grains per cubic foot or per pound of air. The ratio of the vapor actually contained in the air to the maximum amount the air will hold at the same temperature is called the relative humidity. For example a pound of air at 70 degrees Fahrenheit with an absolute humidity of 55 grains per pound is only 50 per cent saturated, since at this temperature saturated air holds 110 grains of moisture per pound.

The humidity of the air is determined usually by means of a sling psychrometer. This instrument consists of two ordinary mercury thermometers mounted side by side on a metal strip pivoted to a handle. The bulb of one of the thermometers is covered with a cotton or silk wick which is kept moist with clean water, and the instrument is whirled rapidly and read at frequent intervals, until the lowest reading is obtained. If the air is not saturated the absorption of heat in vaporizing the moisture from the wet bulb lowers the temperature of the bulb to a degree depending upon the humidity of the air. The lower the moisture content of the air the greater the wet bulb depression. When the air is saturated the dry and wet bulb temperatures are identical.

With these two readings, the absolute humidity, relative humidity and dew point temperature can be determined by means of a psychrometric chart, a simple form of which is shown

in figure 1. This chart consists of two principal axes, the horizontal representing the scale of dry bulb temperatures and the vertical representing the scale of grains of moisture per pounds of dry air. The diagonal and practically parallel lines represent the wet bulb temperature. Their intersections with the dry bulb or vertical lines give the relative humidity in per cent. The relative humidity is shown by the set of curved lines extending upward to the right and spaced in intervals of 10 per cent relative humidity, from 10 to 100 per cent. The scale of wet bulb and dew point temperatures is given along the saturation line.

As an example of the use of the chart, assume a dry bulb temperature of 70 degrees and a wet bulb of 62 degrees. To find the relative humidity, pass vertically from 70 degrees dry bulb on the horizontal scale to the 62 degrees wet bulb line, and read 65 per cent relative humidity at the point of intersection. From this point pass horizontally to the scale at the left edge of the chart where it will be found that the air has an absolute humidity

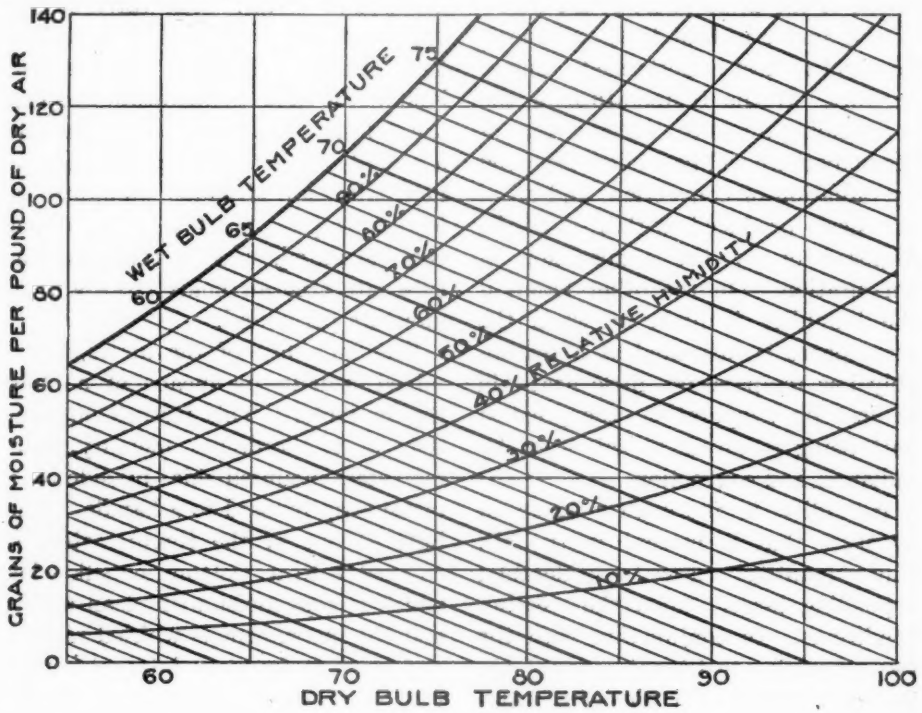

FIG. 1. PSYCHROMETRIC CHART FOR DETERMINING ABSOLUTE HUMIDITY, RELATIVE HUMIDITY AND DEW POINT TEMPERATURE

The intersection of the diagonal lines representing wet bulb temperature with the dry bulb or vertical lines gives the relative humidity in per cent. The position of this point on the vertical scale at the left gives the absolute humidity in grains per pound.

of 70 grains per pound. The intersection of this horizontal line with the saturation curve gives a dew point temperature of 57.3 degrees. At this temperature saturation will occur if the air is cooled without adding or subtracting moisture. If the temperature of the air is reduced further, part of this moisture will condense, the dew point will be lowered, and the absolute humidity will be correspondingly less.

The moisture absorbing power of the air from the surface of a wet body depends, strictly speaking, upon the difference between the vapor pressure at the surface of the body and the vapor pressure of the air. The greater this difference the greater the evaporation from the wet surface. For all practical purposes the relative humidity of the air can be taken as an approximate index of its moisture absorbing power.

EQUIVALENT CONDITIONS OF TEMPERATURE, HUMIDITY AND AIR MOVEMENT

The amount of heat carried off by radiation and convection depends, as we have seen, upon the temperature of the air and the amount of its motion, while the evaporative cooling effect depends upon the capacity of air for absorbing moisture and upon its movement. Heat loss, both by convection and evaporation, is greatly accelerated in the presence of wind, which carries away the warm and saturated film of air in contact with the body and replaces it with cooler and dryer air.

These three physical factors of the atmosphere may vary considerably while their combined effect upon the human body still remains the same. In other words, if the temperature of the air is increased, either its humidity must be correspondingly decreased or the velocity of the air must be increased if the rate of heat loss from the human body, or personal comfort or discomfort, is to remain unchanged. Combinations of temperature, humidity, and air movement which produce the same feeling of warmth are called equivalent conditions. For example, 73 degrees dry bulb and 25 per cent relative humidity with still air is equivalent to 66 degrees dry bulb and 80 per cent relative humidity. But with an air velocity of 500 feet per minute the dry bulb temperature of the latter condition must be increased to 79 degrees for the same feeling of warmth and same comfort.

DETERMINATION OF LINES OF EQUAL COMFORT

To determine the equivalent conditions and at the same time to study the relation of the three principal physical qualities of air to human comfort or discomfort, the Research Laboratory of the American Society of Heating and Ventilating Engineers designed two adjoining psychrometric rooms, 8 by 17 by 10 feet, at the Pittsburgh Experiment Station of the United States Bureau of Mines. The walls, ceilings and floors of the rooms are well insulated with cork board. An up-to-date air conditioning equipment in an adjoining room supplies the psychrometric chambers with conditioned air, controlled both thermostatically and by means of hand operated fractional valves, so that conditions can usually be maintained within 0.5 degree. The tem-

perature, humidity and air movement in each chamber can be controlled independently of each other, and the temperature can be varied from 25 degrees in winter to about 180 degrees dry bulb.

The first series of experiments was conducted with still air in the psychrometric chambers using three normal healthy men as judges of the temperature conditions. The upper half of their bodies was kept uncovered to insure greater sensibility of warmth. A condition of comparatively high dry bulb temperature and low humidity was produced and maintained in one of the chambers, referred to later as the "dry room," while the second or "wet room" was set at a lower temperature but higher humidity. The judges passed back and forth from one chamber into the other comparing the feeling of warmth of the two conditions. The dry and wet bulb temperatures in the wet room were then varied until all three judges agreed that the two rooms felt equally warm. Thus a number of such conditions were found equivalent to the one in the dry room, which was maintained constant throughout the experiment.

By following the same procedure for higher and lower temperatures in the dry room, all equivalent conditions from 30 to 150 degrees dry bulb temperature were determined. The dry and wet bulb temperatures of these sets of equivalent conditions were then plotted on a psychrometric chart similar to that shown in figure 1. It was found that the points, so plotted, constitute straight lines which assume an intermediate position between the dry bulb and wet bulb temperature lines.

A psychrometric chart with these lines of equal comfort superimposed for each degree of saturation temperature is shown in figure 2. Any combination of dry and wet bulb temperatures on any line is equally warm and equally comfortable to all other similar combinations on the same line.

Given, for example, a dry bulb temperature of 70 degrees and a wet bulb of 62 degrees, it will be found in the chart that this condition lies on the 66 degree comfort line. This value is read on the saturation temperature scale by passing diagonally parallel to the comfort line through the point of intersection of the dry and wet bulb temperatures. Any other condition shown on this line, such as 78 degrees dry bulb and 53 degrees wet bulb, is equivalent, that is, it feels just as comfortable and just as warm as the given condition.

It will be observed that at low temperatures the lines of equal comfort become parallel to the dry bulb temperature lines, while at high temperatures they are more nearly parallel to the wet bulb lines. This can be explained from the fact that at low temperatures the surface of the body is dry and it therefore approaches the thermal properties of a dry bulb thermometer. At high temperatures when the surface of the body is wet with perspiration the body approaches the condition of a wet bulb thermometer.

For ordinary temperatures, it will be noted in the chart that the lines practically bisect the angle formed by the dry and wet bulb lines, indicating that under normal conditions the two temperatures are of equal importance to human comfort.

Incidentally, in parallel with this work the three services engaged on this investigation determined the physiological reactions of individuals to various atmospheric conditions. Men were exposed to constant temperature conditions for a period of three hours, or else as long as they could endure the exposure. Frequent observations of body temperature, pulse rate, blood pressure and loss in weight were made before, during and after the tests. An analysis of these results showed that the physiological responses correlated much more closely with the newly developed index of comfort than with any other index, such as dry bulb temperature, wet bulb temperature, relative humidity or dew point. In other words, rise in body temperature per hour, increase in pulse rate, and loss in weight by perspiration were found to be the same for all equivalent conditions of the same comfort index, irrespective of dry bulb, wet bulb, relative humidity or dew point temperature.

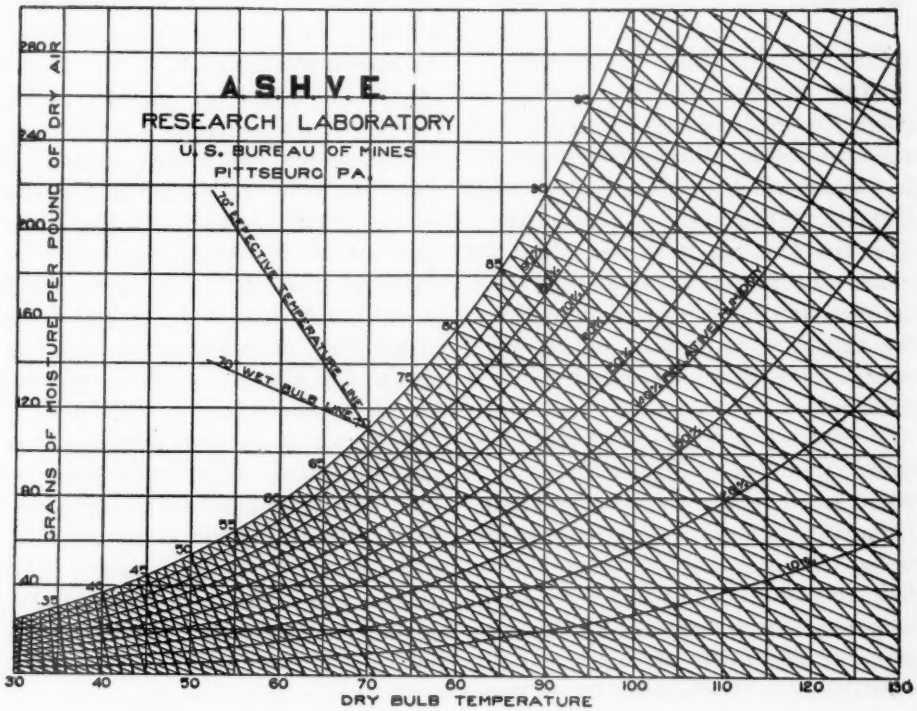

FIG. 2. PSYCHROMETRIC CHART SHOWING EFFECTIVE TEMPERATURE LINES FOR STILL AIR CONDITIONS

The warmth and comfort of any combination of dry and wet bulb temperatures on any effective temperature line is equal to the warmth and comfort of all other similar combinations on the same line.

It follows therefore that the newly developed scale of comfort, which was fundamentally based upon the pri-

mary sensory impressions perceived through the temperature sense areas of the skin, is not only an index of the degree of warmth in the body, but also determines the physiological effects of exposure to temperature conditions. For this reason this comfort index has been called effective temperature.

THE ZONE OF GREATEST COMFORT

After determining the equivalent conditions and effective temperature scale for still air, the next step was to find which conditions were most comfortable to the human body at rest. This problem has been the object of much speculation during the last few decades, and the heating and ventilating engineers, physicians and physiologists were alike interested in its solution.

It will be readily seen that the results would be of little value if they were based upon only a few individuals. Different people require different temperatures for personal comfort, and the scope of this investigation was therefore to establish the comfort zone within which the average individual was comfortable as far as temperature is concerned.

Accordingly a large number of people of both sexes totaling 130 in all participated in these experiments. Care was taken to select a representative group of people, engaged in different occupations and wearing customary but widely different types of indoor clothing. The psychrometric chambers were furnished with living room commodities and small tables were provided for light activities of the subjects, such as, card playing, reading, writing, and the like.

In preliminary experiments with 12 subjects the probable upper and lower boundaries of the comfort zone were established. Starting well outside these two limits with the total number of subjects, the probable conditions of maximum comfort were approached from both directions to eliminate any possible effect of acclimatization to the same temperature.

A fresh supply of conditioned air was provided at all times, the temperature of which was kept constant for about an hour, or until the subjects of the experiments formed definite opinions as to whether the condition was cold, comfortable or warm. The humidity during these experiments varied from 30 to 60 per cent, and no measurable amount of work was performed by the subjects.

The analysis of the results shows that at 58.5 degrees effective temperature the 130 subjects unanimously agreed that the condition was too cold, while an effective temperature of 72.5 degrees was pronounced too warm for comfort. These two effective temperature lines constitute the extreme lower and upper boundaries of the comfort zone.

At 61.5 degrees effective temperature half of the subjects were comfortable and the other half were cold, while at 70 degrees effective temperature the condition was pronounced comfortable by half of the subjects and too warm by the other half. This narrower zone may be taken as the comfort zone within which the average individual is comfortable.

Finally it was found that the conditions of maximum comfort are represented by the 64.5 degree, effec-

tive temperature line, irrespective of dry bulb or relative humidity, at which temperature about 98 per cent of the total number of subjects were comfortable. In round figures the 64.0 effective temperature line is the true comfort line to be adopted as the standard in heating and ventilating residences, schools, theaters, office buildings and all other places where mental work and light muscular activities are pursued.

THE COOLING EFFECT OF WIND

The cooling effect of wind was known many centuries ago and is extensively used at present to improve uncomfortable conditions arising from high temperatures. To establish a quantitative measure of the cooling effect of wind on the human body at various temperatures and humidities, two wind tunnels were built, one in each of the psychrometric chambers of the Research Laboratory. At one end of the tunnel in one chamber, referred to later as the velocity room, a large number of fans were arranged so as to produce uniform velocities within the tunnel.

The method followed in determining the equivalent conditions with moving air was practically similar to that employed in the still air experiments. Briefly, the still air tunnel was set at the desired temperature and humidity. A constant air velocity was produced and maintained in the velocity tunnel, the temperature conditions of which were changing as the subjects walked back and forth from one tunnel into the other, until a temperature was reached at which the condition with moving air was equally warm as the one with still air.

The relative humidity in the two tunnels was always kept the same, so that the difference in their dry bulb temperature represents the cooling effected on the human body by the particular velocity. Such equivalent conditions having the same relative humidity are called corresponding equivalent conditions.

The velocity in these experiments varied from 150 to 500 feet per minute, and the same range of temperature and humidity was employed as in the still air experiments. The subjects were stripped to the waist and stood side by side at the middle of the tunnel facing the fans.

Figure 3 shows a representative psychrometric chart with the effective temperature lines for 300 feet per minute velocity superimposed. As a distinguishing feature these lines are drawn heavily and their numerical values are given at their lower end. The effective temperature lines with still air are shown by the straight solid lines in contrast to the wet bulb lines which are drawn dotted in this chart.

It will be observed that unlike the effective temperature lines with still air the lines with moving air are not straight all over the chart, but are distinctly curved for temperatures from above the comfort zone to body temperature. At low temperatures air movement increases heat loss by evaporation and convection. As a result the surface of the body becomes dry, and the body approaches the thermal properties of a dry bulb thermometer, as shown by the effective temperature lines becoming straight and parallel to the dry bulb lines. At high temperatures, when the surface of the body is completely wet with

perspiration the effect of the wind is to change the temperature of the surface so that it approaches the wet bulb temperature of the air. The latter thus becomes the predominent factor of the severity of exposure, and the effective temperature lines flatten out and become parallel to the wet bulb lines.

For intermediate temperatures, the degree of wetness of the body surface varies from an appreciable state of perspiration at high to insensible perspiration at low humidities. This property of the human body causes the heat loss by evaporation to vary due to air motion, depending upon the amount of moisture available, as a result of which the lines curve downward with decreased humidity.

The effective temperature of a condition is determined by the line passing through the point of intersection of the dry bulb and wet bulb temperature on the chart corresponding to the velocity of the air. The difference between the effective temperature of the condition with still air and that with the given velocity is a measure of the cooling produced by that particular

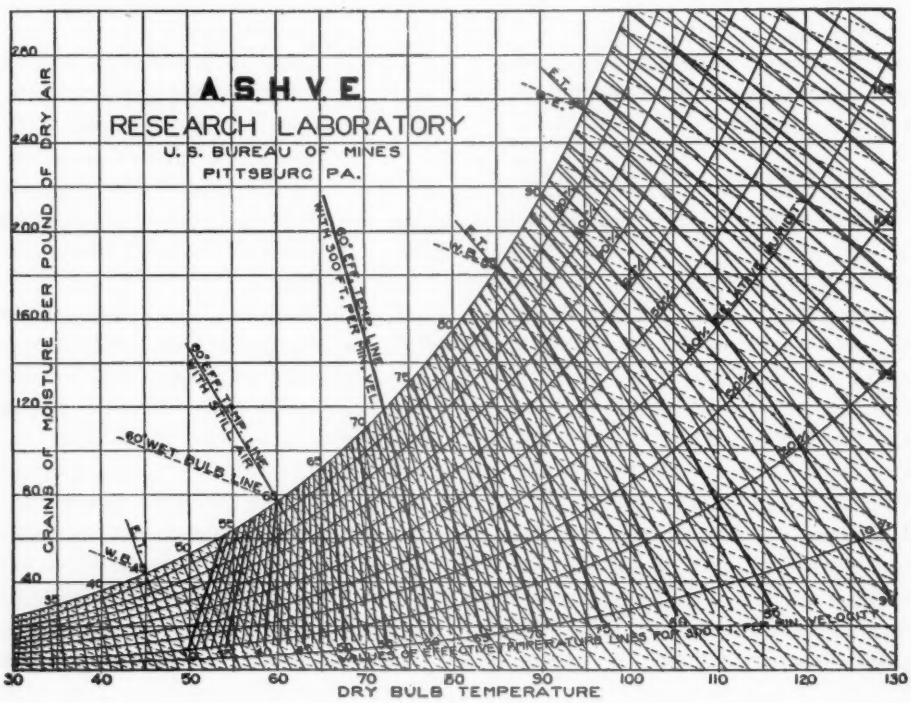
A.S.H.V.E.
RESEARCH LABORATORY
U. S. BUREAU OF MINES
PITTSBURG PA.
GRAINS OF MOISTURE PER POUND OF DRY AIR
DRY BULB TEMPERATURE
60° WET BULB LINE
60° EFF. TEMP. LINE WITH STILL AIR
60° EFF. TEMP. LINE WITH 300 FT. PER MIN. VEL.
VALUES OF EFFECTIVE TEMPERATURE LINES FOR 300 FT. PER MIN. VELOCITY

FIG. 3. PSYCHROMETRIC CHART SHOWING EFFECTIVE TEMPERATURE LINES FOR STILL AIR AND FOR AIR CONDITIONED WITH 300 FEET PER MINUTE VELOCITY

The heavy lines represent the effective temperature for 300 feet per minute velocity superimposed upon the effective temperature lines with still air. The difference between the effective temperature of the condition with still air and that with the given velocity is a measure of the cooling produced by that particular movement.

movement. Similarly, the difference between the dry bulb temperature of the condition and the dry bulb of the corresponding equivalent condition with still air gives the cooling in degrees dry bulb temperature.

Assuming air at 80 degrees dry bulb and 71 degrees wet bulb moving at a velocity of 300 feet per minute, figure 3 shows that the effective temperature will be 67 degrees, the effective temperature with still air, 74.7 degrees, the cooling preduced by air motion 74.7 − 67.0 = 7.7 degrees effective temperature. The dry bulb of the equivalent condition with still air is found to be 71.0 degrees and the cooling in degrees dry bulb temperature is 80.0 − 71.0 = 9.0 degrees.

The cooling produced by any velocity varies with both dry and wet bulb temperature. For ordinary temperatures it is maximum at saturation and minimum at low humidities, due to the fact that in the latter case the capacity of air for absorbing moisture is so great that all the perspiration available on the surface of the body is evaporated without the aid of air motion.

As the temperature of the air increases the cooling effect of wind decreases until at certain conditions of temperature and humidity the effect of air movement becomes zero. These neutral conditions are represented by the upper dotted line passing through a saturation temperature of about 100 degrees and extending diagonally to the right of the chart.

In this connection it should be noted that air movement does not always cool the human body. The neutral line constitutes the border line separating the cooling zone below, in which air movement produces a cooling effect on the body, from the heating zone above, in which air movement heats the body. In general it can be stated that air motion cools the human body as long as the wet bulb temperature is below body temperature (99°F.) irrespective of dry bulb temperature.

Another interesting fact worth noting is the reversal in the direction of the effective temperature lines in the cool region of the chart. It will be observed in Figure 3 that with 300 feet per minute velocity and a dry bulb temperature of 63 degrees, dry bulb is the only factor in human comfort, while below this temperature for the same dry bulb the higher the humidity the cooler the condition, and vice versa.

VARIATION OF COOLING WITH VELOCITY

Considering next the variation of cooling with velocity, figure 4 shows this relation in terms of effective temperature for a relative humidity of 60 per cent. The effective temperature is represented by the curved lines spaced in two degree intervals, and is determined from the dry bulb, relative humidity, and velocity of air. On the right of the chart is given the scale of dry bulb temperature while on the left, the zero velocity line constitutes the scale of effective temperature. The effective temperature of any condition is determined by passing from the point of intersection of the dry bulb temperature and velocity, parallel to the curved lines, to the scale at the left. The effective temperature of the condition with still air is read on the same scale by passing horizontally

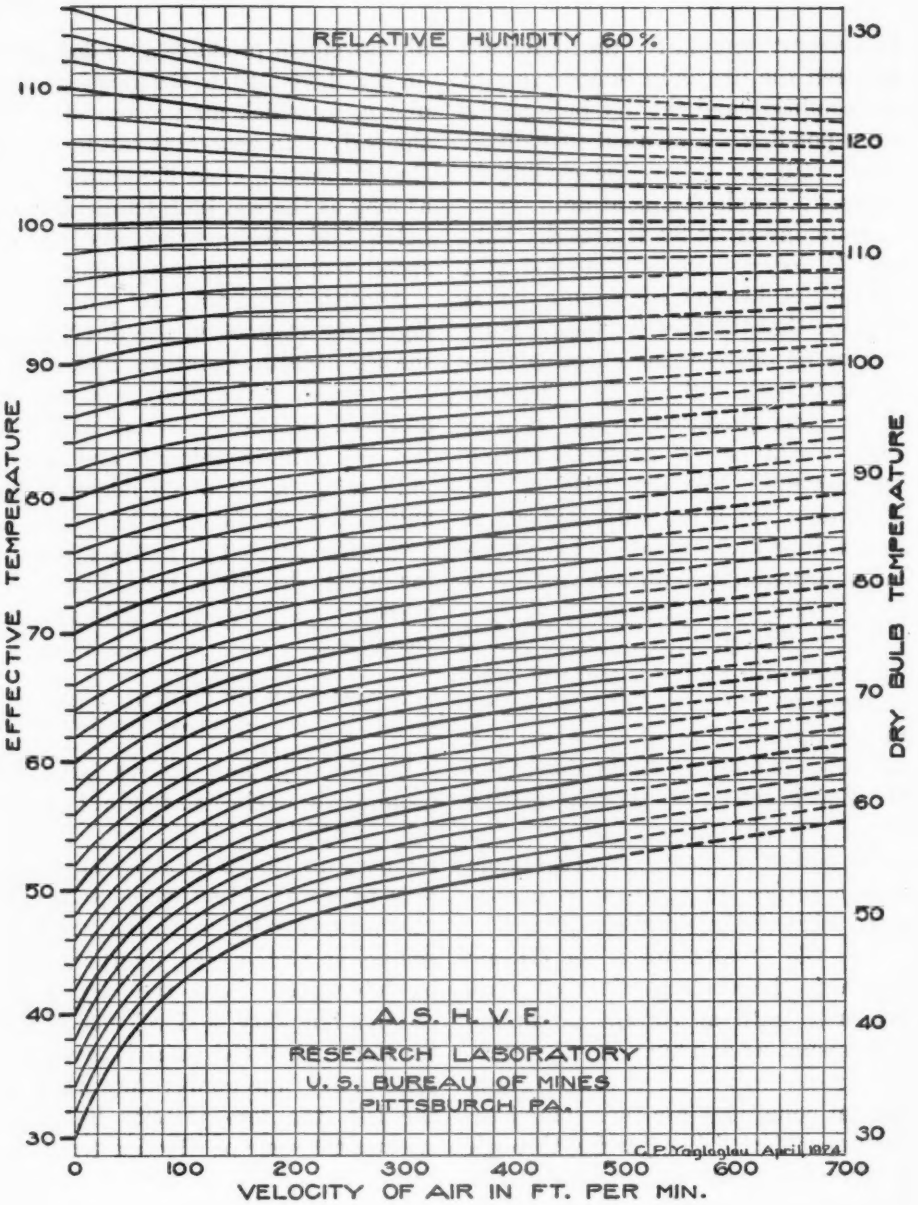

FIG. 4. VARIATION OF COOLING WITH AIR VELOCITY. EFFECTIVE TEMPERATURE PRODUCED BY AIR MOVEMENT FOR AIR CONDITIONED WITH 60 PER CENT RELATIVE HUMIDITY

from the point of intersection. The difference between the two values represents the cooling produced by the particular velocity. To find the cooling in degrees dry bulb, follow the effective temperature line of the condition to zero velocity and read the corresponding dry bulb temperature on the scale on the right. The difference between the dry bulb of the given condition and that found is the cooling in degrees dry-bulb temperature.

As an example of the use of the chart assume a condition of 80 degrees dry bulb, 60 per cent relative humidity, and 300 feet per minute velocity. From figure 4 it is found that the effective temperature will be 66.5 degrees, the effective temperature with still air 74 degrees, and the cooling produced by the movement of the air 74 — 66.5 = 7.5 degrees effective temperature. The dry-bulb temperature of the equivalent condition with still air is 71.2 degrees and the cooling in degrees dry bulb will be 80 — 71.2 = 8.8 degrees.

If it is desired to find the velocity required to reduce the original condition to 64 degrees effective temperature pass horizontally from the dry bulb temperature of 80 degrees to the left until the 64 degrees effective temperature line is crossed. Then read vertically down from this point of intersection the velocity value of 450 feet, to which the air movement must be increased for maximum comfort.

The variation of cooling with velocity and temperature is shown by the change in the curvature and slope of the lines. It is of interest to note that doubling the velocity does not double the cooling, but low velocities are considerably more efficient than high. In other words the increase of cooling with velocity is greater for low velocities and decreases as the velocity increases. Above 300 feet per minute cooling becomes practically a straight line function of velocity. Because of this fact, the effective temperature lines were extended dotted to 700 feet although the highest velocity employed in the experiments was 500 feet per minute.

TABLE FOR DETERMINING EFFECTIVE TEMPERATURE

The last two charts discussed are representative of two groups of charts. They are presented here for the purpose of showing the general tendencies, characteristics and relation of the effective temperature lines to the principal physical qualities of air. Several of these charts, rather cumbersome to manipulate, are required to cover the entire field of effective temperature. For this reason a table[2] has been prepared, from which the information given in the various charts can be obtained either directly or by simple interpolation.

[2] Published in full in Jour. Amer. Soc. of Heating and Ventilating Engineers, July, 1924, pp. 524 ff.

II. Practical Application to Ventilation Problems of Industry[3]

The fundamental laws of the thermal properties of the human body find many applications in the routine of life. During the past few years the need for artificially cooling school rooms, theaters, auditoriums, and other occupied spaces in warm weather has attracted considerable attention. Many adverse conditions such as those found in factories, mines, and steel, iron and glass works produce fatigue and affect injuriously the health of those exposed. The economic loss resulting through reduced efficiency cannot be over-emphasized, and in many instances it becomes necessary to suspend operations because of the inability of men to endure the extreme temperature conditions.

In cases where air motion produces considerable cooling it is the simplest and most inexpensive method available. At high temperatures, however, the benefit derived from movement of the air is small, and steps should be taken to reduce the effective temperature by other means prior to setting the air in motion.

One of the most important principles of air conditioning is manifested in the cooling produced by the evaporation of water. When air partly saturated comes in contact with water, as for instance by passing it through a humidifier, a certain amount of heat is absorbed from the air in the process of evaporation, effecting an appreciable lowering in the temperature of the air. The wet-bulb temperature remains the same if no heat is added or subtracted from the system, the sensible heat of the air being transformed to latent heat. Ultimately the dry-bulb temperature of the air is reduced to that of the wet bulb when the air becomes completely saturated.

Referring to figure 3 assume a condition of 110 degrees dry bulb and 85 degrees wet bulb. The effective temperature is 91 degrees, and it will be found that a velocity of 300 feet per minute produces a cooling of only 2 degrees. By passing this air through a humidifier where the water is recirculated and not heated we pass to the left of the chart along the 85 degrees wet-bulb line until saturation is reached. The dry-bulb temperature of the air is reduced from 110 to 85 degrees and its effective temperature from 91 to 85 degrees, effecting a cooling of 25 degrees dry bulb and 6 degrees effective temperature. A velocity of 300 feet now applied will produce a further cooling of 5.5 degrees effective temperature on the human body at rest and stripped to the waist, as compared with 2 degrees prior to saturation, and the original condition of 91 degrees effective temperature is thus theoretically reduced to 79.5 degrees effective temperature.

It is of interest to note that in addition to the cooling obtained from the evaporation of water, the effect of air movement reaches a maximum value

[3] Extracts from "Effective Temperature Applied to Industrial Ventilation Problems," by C. P. Yagloglou and W. Edw. Miller, Jour. Amer. Soc. of Heating and Ventilating Engineers, July, 1924.

at saturation, and an enormous amount of cooling results from the combination of the two. This method of artificial cooling is very promising to many hot operations in industries where the humidity of the air is not very high. The air is simply saturated and blown upon the workers. The process involves the use of simple and inexpensive equipment as compared with refrigeration, such as humidifiers and fans, and it is very likely that this most efficient method of artificial cooling will be extensively used in the future.

APPLICATION TO SEDENTARY CONDITIONS

It is a well known fact that there is an optimum temperature of the environment most conducive to human comfort, and at which the body works most efficiently. This optimum temperature depends largely upon the nature of the work performed. The heat produced through the chemical changes within the body must be lost to the outside for the body temperature to remain constant. The greater the muscular activity the greater the heat produced, and the cooling power of the air should be correspondingly increased to effect a greater heat loss from the human body.

The optimum temperature for individuals at rest, or otherwise engaged in light activities, in still air and normally clothed was found by the Research Laboratory[4] to be 64.5 degrees effective temperature. In round figures an effective temperature of 64 degrees should be adopted for dwellings, office buildings, theaters, schools and all other places where mental and light muscular work is performed in practically still air.

Table 1 gives the conditions corresponding to the effective temperature of 64 degrees in terms of dry bulb and wet bulb with still air and their variation with velocity. Although only the data for still air were determined experimentally by a great variety of individuals, a comparison of a number of equivalent conditions with still air and with 500 feet velocity, made by a few persons normally clothed, disclosed no definite variation. While all equivalent conditions are equally comfortable practical considerations limit the range of humidity to be ordinarily employed from 30 to 70 per cent. As a general rule relative humidities from 50 to 60 per cent will be found most desirable.

Subsequent experiments will determine the optimum temperature for individuals doing various amounts of work, both in still and in moving air of different velocities, so that a standard can be set for every respresentative industry.

APPLICATION TO FACTORIES AND WORKSHOPS

The influence of atmospheric conditions in factories and workshops upon the health and well-being of the occupants cannot be overlooked. The industrial worker spends the major part of his active life in an environment where heat, moisture, and in

[4] Determination of the Comfort Zone and Further Verification of Effective Temperature within this Zone, by F. C. Houghten and C. P. Yagloglou, Jour. Amer. Soc. of Heating and Ventilating Engineers, September, 1923.

some special cases, injurious elements are constantly evolved by the process of manufacture. The conditions, as a result of their effect on the health and comfort of the workers, are chiefly responsible for the quantity and quality of output and, therefore, for the general efficiency of the plant.

In a report of the importance of temperature and humidity to physical work the New York State Commission on Ventilation states that men perform 28 per cent less physical work in a temperature of 86 degree Fahrenheit with 80 per cent relative humidity than in one of 68 degrees Fahrenheit and 50 per cent relative humidity. An estimate of the daily loss in output in an average size industrial plant operating at an efficiency of 70 per cent will reveal the material financial loss resulting from failure to control the temperature conditions.

It is a comparatively simple matter to produce and maintain proper atmospheric conditions indoors in winter. In summer, however, with an outside temperature in the neighborhood of 95 degrees the problem becomes rather complicated. The incoming air diffusing into the workrooms takes up heat liberated from the machinery in operation and from the bodies of the workers, and its temperature is increased considerably.

While every factory is equipped with a heating system, little provision is made for cooling during the hot summer months, despite the fact that the greatest seasonal fluctuations in efficiency occur in summer.

It has been shown in general how high temperature conditions can be improved by means of saturation and air movement. As an actual application of the method the case of an automobile factory is taken, where the average summer observations available for 1923 were about 96 degrees dry bulb and 80 degrees wet

TABLE 1

Giving comfortable conditions, in terms of dry and wet bulb temperature, for normally clothed people at rest, in still and moving air

RELATIVE HUMIDITY	STILL AIR		VELOCITY OF AIR IN FEET PER MINUTE									
	0 feet		50 feet		100 feet		200 feet		300 feet		500 feet	
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	Dry bulb	Wet bulb	Dry bulb	Wet bulb	Dry bulb	Wet bulb	Dry bulb	Wet bulb
per cent												
100	64.0	64.0	67.3	67.3	69.9	69.9	72.8	72.8	74.8	74.7	77.5	77.5
90	65.0	63.0	68.2	66.1	70.7	68.5	73.6	71.3	75.5	73.2	78.3	76.0
80	66.0	62.0	69.1	65.0	71.4	67.0	74.3	69.8	76.3	71.5	79.1	74.2
70	67.1	60.7	70.1	63.4	72.3	65.4	75.1	68.0	77.1	69.7	79.9	72.2
60	68.2	59.4	71.1	61.9	73.3	63.8	76.0	66.1	77.9	67.7	80.6	70.2
50	69.4	58.0	72.3	60.3	74.3	62.0	77.0	64.2	78.7	65.6	81.4	67.8
40	70.7	56.4	73.4	58.5	75.4	60.0	77.9	62.0	79.5	63.1	82.1	65.1
30	72.2	54.5	74.7	56.4	76.5	57.6	78.8	59.2	80.3	60.3	82.8	62.0
20	73.8	52.4	76.0	53.9	77.8	55.0	79.7	56.2	81.1	57.1	83.6	58.6

bulb with practically still air. From the charts it will be found that this condition corresponds to an effective temperature of 84.7 degrees, and that a velocity of 300 feet will improve the situation by only 3.5 degrees effective temperature. Saturating the air, however, the dry-bulb temperature is reduced to 80 degrees, and a velocity of 300 feet now applied will theoretically reduce the condition to about 72 degrees effective temperature producing a total improvement of 84.7 − 72.0 = 12.7 degrees effective temperature.

In practice these theoretical values cannot be attained. Allowance must be made for the increase in temperature and decrease in the humidity of the air in diffusing into the workroom before striking the bodies of the workers. In addition the values will probably be affected by the clothing worn, and the type of work performed.

In large factories the process requires the use of humidifiers and blowers, the latter forcing through ducts the cool air directly upon the workers. In addition to the cooling effect, a fresh supply of air is provided at all times to remove the products of respiration and various other injurious elements evolved by the process of manufacture.

In small factories and workshops the desired cooling power of the air can be obtained by locally applied electric fans directing a current of air upon the workers. The velocity of the air being comparatively high a few feet from the fans the cooling produced by the wind alone will be sufficient in the majority of cases, without the use of humidifiers.

APPLICATION TO MINING INDUSTRY

Until recently the problem of mine ventilation from the standpoint of maintaining proper purity of the air underground was given considerable attention from the part of many investigators. However little was accomplished in the way of providing better working conditions essential to the well-being and efficiency of the miners.

Adverse conditions of temperature and humidity in many mines impair the health and vitality of the workers and lower the output, with the consequent immense financial loss to the owners of the mines. Orenstein and Ireland[5] estimated by means of a dynamometer and ergometer the working efficiency of miners on the Rand. Their results, given below, are based on dry Kata cooling powers with the assumption that the working efficiency is 100 per cent at a dry Kata power of 6 millicalories per square centimeter per second.

Dry Kata cooling power..	1	2	3	4	5	6
Working efficiency per cent.....	50	60	70	80	90	100

It will be observed that the working efficiency decreased when the Kata power fell below 6 until at 1 millicalorie per square centimeter per second, the average efficiency was only 50 per cent, while the bodily temperature rose considerably and extreme fatigue was produced by work. Many

[5] Contribution to the Study of the Influence of Mine Atmospheric Conditions on Fatigue, by A. J. Orenstein and H. J. Ireland, Journal of the South African Institution of Engineers, March, 1921.

similar cases can be given where the temperature conditions underground were such that the miners could remain at work only half of the time, spending the other half in cooling off and rest.

In a study of the physiological effects of high temperatures and high humidities in metal mines, Sayers and Harrington[6] found that in a still atmosphere of 80 to 90 degree Fahrenheit, manual labor caused the body temperature to rise in a short period to 102 degrees, and frequently to 103 degrees when the relative humidity exceeded 95 per cent. The pulse rate increased rapidly accompanied by physical weakness, exhaustion, inability to think, and a marked loss in weight. However, with air velocities of between 400 and 500 feet per minute, there was no marked change in body temperature or pulse rate, and no appreciable discomfort was experienced.

A velocity of 500 feet per minute at a temperature of 90 degrees dry bulb and 95 per cent relative humidity produces a cooling of 6.5 degrees effective temperature on the human body. The original condition corresponds to 88 degrees effective temperature, while that effected by the movement of the air is 81.5 degrees effective temperature, a rather comfortable temperature for men accustomed to work in mines.

It is obvious from the above that the cooling effect of moving air is of utmost importance in the mining industry. In places where the temperature and humidity cannot be readily reduced, or in small or shallow mines where the investment involved in the installation of a mechanical system of ventilation is not justified, the velocity of the air may be increased by means of locally applied fans to produce the desired cooling on the workers.

TABLE 2

MINE	DRY BULB TEMPERATURE	WET BULB TEMPERATURE	VELOCITY FEET PER MINUTE	E.T.	REMARKS OF WORKERS
Royal Lode	88.7	88.0	0	88.5	Unendurable
Royal Lode	88.0	84.7	360	79.8	Good for work
Royal Lode	87.0	83.0	710	72.5	Excessive velocity
Waihi Mines, 1450 foot level	81.4	80.2	0	80.7	Oppressive
Waihi Mines, 1450 foot level.	80.2	78.6	770	64.0	Excessive velocity

Table 2, compiled by Lewis[7] shows the effect of increasing the velocity of air in the working places. (The effective temperature of the various conditions is introduced in the table to afford a base for comparison.)

[6] Physiological Effects of High Temperature and Humidity with and without Air Motion, by R. R. Sayers and D. Harrington, U. S. Bureau of Mines, Report of Investigation, Serial No. 2464.

[7] Some Kata-Thermometer Observations, in Tonapah Mines, Nevada, by R. S. Lewis, Engineering and Mining Journal Press, March, 1924, p. 364.

It will be seen that the improvement in the conditions is solely due to increasing the velocity of the air. Various other investigations, such as those of Haldane, Harrington, and the latest findings of the Research Laboratory, indicate that the upper limit of temperature efficiently endured with manual labor is 80 degrees effective temperature.

Up to the present time considerable effort and money has been spent in attempts to produce better conditions for the mine workers, and a number of failures have resulted from inability to control the cooling power of the air underground.

The principle object to be attained in mine ventilation is to reduce the temperature at the working places underground, to provide a supply of fresh air and to dilute and remove noxious fumes, dust, and inflammable gases resulting from the use of explosives.

The atmospheric conditions at the working places of a mine depend largely upon rock temperature, depth of the mine, and presence of water in the shafts and drifts available for evaporation. In comparatively shallow mines, and those ventilated by natural circulation, the temperature of the air in the workings depends to a greater extent upon the outside air temperature.

As the air descends the downcast shaft its temperature is increased through the absorption of heat from the surrounding rock, and also through the higher barometric pressure. According to Haldane, the increase in rock temperature is about 1 degree Fahrenheit for every 70 feet of depth, while cases have been reported where the same increase was observed in from 40 to 180 feet of depth. A certain quantity of heat is also added to the air at the bottom of the mine through the use of machinery, explosives and various other operations, these further raising its temperature. The moisture content of the air, as it travels down the shaft, also increases depending upon the temperature and amount of water available for evaporation.

The difficulties in maintaining proper working conditions in mines are obvious. If the incoming air is cooled by refrigeration the greater difference in temperature between rock and air will effect a greater heat absorption with the ultimate result of the air reaching the bottom at practically the same temperature as it would without cooling. Actual observations by Davies[8] in Morro Velho Mine in Brazil show that the incoming air at a temperature of 76 degrees arrived at the bottom with a temperature of 101 degree, and when cooled by refrigeration to 42 degrees reached the same level at a temperature of 97.4 degrees.

This proves that owing to the extremely low efficiency the use of refrigeration in mine ventilation is prohibitive. In addition, its first cost and cost of operation is many times greater than the corresponding cost of

[8] The Air Cooling Plant, St. John del Rey Mining Co., Ltd., Brazil, by E. Davies, Transactions, Institute Mining Engineering, Vol. LXIII, London, 1922. Also, Cooling of Mine Air, U. S. Bureau of Mines Report of Investigations 2554, by T. T. Reed and F. C. Houghten.

the simple and efficient equipment involved in the application of the new principles of air conditioning to mine ventilation.

As mentioned before, evaporation of water effects a marked lowering in the temperature of the air especially when the latter is comparatively dry. It has been observed in a few mines that under favorable conditions the cooling resulting from evaporation of water dripping along the walls of the downcast shaft and drifts more than counteracted the increase in temperature, and the air reached the bottom at a lower dry bulb than on entering the shaft at the top of the mine.

This principle of cooling should be frequently made use of in mines, either naturally or artificially by means of humidifiers or sprays, especially when the temperature conditions are such that no reasonable velocity of the air is sufficient to produce a decided improvement.

To illustrate, the case of a hot metal mine is taken when the dry-bulb temperature was about 105 degrees and the wet bulb 88 degrees. This condition corresponds to 91.7 degrees effective temperature, and the men could only remain at work for about an hour without rest. It is found that the velocity necessary to reduce this condition to 80 degrees effective temperature is above 700 feet and therefore impracticable. If, however, the air is previously cooled by evaporation of water its temperature will be reduced to 88 degrees, and the resulting cooling by saturation alone will be 3.7 degrees effective temperature. A velocity of about 600 feet per minute now applied will probably be sufficient to reduce the condition to 80 degrees effective temperature producing a total improvement of 11.7 degrees effective temperature.

The financial aspects of cooling by saturation and air motion can be demonstrated by a study of the cooling plant at the Morro Velho Mine. The average underground condition existing prior to March, 1920, was 101.5 degrees dry bulb and 87.0 degrees wet bulb with a wet Kata cooling power of 7.7 millicalories per square centimeter per second. In April, 1922, an expensive refrigerating equipment was installed at the surface with a capacity of 100,600 B.t.u. per minute together with an additional 200 h.p. Sirocco blower to effect a total air supply of 60,000 cubic feet per minute. Through these changes the dry bulb temperature was reduced from 101.5 to 97.4 degrees, the wet bulb from 87.0 to 76.2 degrees, and the wet Kata cooling power was increased from 7.7 to 20.5 millicalories per square centimeter per second.

Assuming that the wet Kata-thermometer can be depended upon for velocity determinations the computed values are 220 feet per minute prior to March, 1920, and 540 feet after the changes were made. The original condition (101.5 degrees dry bulb, 87 degrees wet bulb, and 220 feet per minute) corresponds to an effective temperature of 88 degrees and was reduced by refrigeration and the increased air movement to 78.7 degrees with a resulting improvement of $88.0 - 78.7 = 9.3$ degree effective temperature. Of this total improvement 7.4 degrees effective temperature is apparently due to refrigeration alone, and

1.9 degrees effective temperature or 20 per cent is due to the increased velocity.

It is of great financial significance to find now that the same improvement could be theoretically obtained by saturation and the increased velocity without the use of the refrigerating equipment. By simply saturating the air both dry bulb and effective temperature are reduced to 87 degrees, when a velocity of about 560 feet per minute will further reduce the condition to 78.7 degrees effective temperature, producing a total improvement equal to that obtained by the combination of refrigeration and air motion.

An estimate of the initial cost and cost of operation of the refrigerating plant, as compared with the corresponding costs of a simple humidifier, will disclose the enormous saving in investment and power consumption accomplished by this method.

COMFORT AND HEALTH OF WORKERS IN STEEL MILLS AND ALLIED INDUSTRIES

In the very hot industries of steel, iron, and tin manufacture the workers depend chiefly on evaporation as the only means of eliminating bodily heat. The work is hard and is carried out under trying conditions of temperature. The men stream with perspiration and drink many kinds of liquids to replace the loss by evaporation. Owing to the heat and excessive perspiration they usually work with the upper half of the body uncovered, and alternate short periods of work with resting periods in which they cool off.

Steel production is the most strenuous occupation in which thousands of men are engaged and often requires exposure to high temperatures which may reach to 220 degrees Fahrenheit a few feet from the furnace. In tin-plate rolling mills the rollerman and behinder usually stand in temperature of from 100 to 120 degrees Fahrenheit working laboriously in the face of radiant heat from the furnaces and plates. In glass works the temperature in the vicinity of the furnace often reaches 140 degrees Fahrenheit, and the workers, like those in the metal industries, frequently rest while others take their places.

Continual exposure to these conditions is found to have an immense economic effect on the efficiency and health of the workers. They become susceptible to disease, and invariably suffer from anemia and muscular and joint pains which eventually induce premature old age.

A great deal has been done lately in an effort to improve working conditions. Forced air blasts have been introduced in a few cases blowing fresh cold air over the heads of the men with beneficial results. Such a system lowered greatly the temperature and improved considerably the efficiency in a tube plant in Pittsburgh. Its use has also been effectual in overcoming adverse heat conditions in bottle works and tin-plate factories and thus has increased considerably the output and decreased respiratory diseases.

Besides the lowering in temperature effected by the circulation of fresh cool air, the movement of the latter greatly increases its cooling effect upon the bodies of the men, and the work pro-

ceeds with shorter periods of rest which otherwise were spent in cooling off.

The experimental evidence in hand of the cooling laws of the human body is of great value in predicting just what is expected of a certain air velocity at a given temperature and moisture content when directed upon the body of lightly clothed individuals. This information further indicates that the most efficient system of ventilating hot workshops is one in which the air is cooled by saturation and then blown through overhead ducts directly over the workers. In addition to increasing the cooling power of the moving air, saturation provides moisture to the relatively dry air and thus eliminates the burning effect of the dry hot air and its influence upon the respiratory organs.

A condition of 112 degrees dry bulb and 86 degrees wet bulb existed in a steel mill in the Pittsburgh district with an average velocity of 100 feet per minute created by the natural circulation of air. It was observed that, in the hot summer months, the work did not proceed as fast as it did in winter, and improvements were contemplated through the installation of large blowers to effect a rapid circulation of air.

In summer, however, the temperature conditions outside are too high to effect any appreciable lowering in the temperature at the working places by this method. Furthermore, as mentioned previously, the effect of wind at these high temperatures is rather small to bring about a decisive improvement.

The effective temperature of the condition is 91.0 degrees, and by saturating the air at 86.0 degrees and blowing it on the workers with a velocity of 400 feet per minutre, it is theoretically reduced to 80.0 degrees which is a good working temperature for steel mills. The cooling produced is 91.0 − 80.0 = 11.0 degrees effective temperature, while, if the velocity of the air is increased to 700 feet, the corresponding effective temperature will be 74.5 degrees and the resulting cooling 16.5 degrees effective temperature.

If the workers could possibly derive the full benefit of the cool air bath these values will be realized in actual practice. In any case the improvement will depend on the effectiveness of directing the current of air upon the workers, and the temperature and humidity of the air as it strikes their bodies.

Book Reviews

A STUDY OF THE CONTENT OF AN ARMY MANUAL ON TRAINING METHODS FOR ALL ARMS

Prepared by Direction of The Adjutant General. Washington, D. C., War Department, Mimeographed W. D. A. G. O. 2-21-24. A. G. 353 Misc. Div. (T&R) pp. circa 160

REVIEWED BY C. S. YOAKUM

Assuming the existence of a textbook on methods of teaching and training in all branches of the army, this 'study' would teach the teachers how to use it and how to make the textbooks that the students of the second and higher orders would need, to learn army procedure. In other words, the manual is not a textbook for students, nor yet for teachers, but one for those who would be expected to plan the courses for teachers and to supervise the work of those who will teach teachers. It is arranged, however, on the plan of applicatory problems or Unit Operations, so that much material for students as well as for the training of instructors is contained in the pamphlet.

To quote from the manual, "This manual must meet the following specifications:

"(1) It must provide an applicatory method for instructing officers of all branches in training policies common to the entire Army, exclusive of map problems and other exercises in tactics.

"(2) It must provide material not only for the student, but also include suggestions for instructors of such a nature that the manual can be used in any and all branches of the service.

"(3) It must provide a method of preparing students to analyze and solve various training problems with a skill equivalent to that which is produced by the present method of handling problems in tactics, namely, to prepare a statement of the mission, an estimate of the situation, the plans of action, and the decision.

"(4) It must provide material for students and instructors whose mental make up is such that an approved solution is necessary to their peace of mind. On the other hand it must also provide material for those students and instructors who have an open mind and an inquiring attitude toward the many problems that confront an officer interested in Army instruction, particularly with respect to those constructive efforts, toward the improvement of methods of conducting every phase of the training of a great citizen army in an emergency, which must constantly be encouraged.

"(5) It should be arranged that it will provide sufficient material that can be used for a wide variety of courses that are required in this subject, not only in the regular army, but also for National Guard, Reserve, and correspondence courses. . .

"The work to be performed by the student of Army Training Methods, as outlined in this Manual, is in the form of Unit Operations, that is in a series of definitely planned assignments each of which is a unit in itself, and each requiring that the student actually *do* something."

The index of operations will give a more definite idea of the content and meaning of this manual. We quote it entire.

"*Unit operations:*

No. 1. Methods used for the control of training.

2. Minimum training specifications.

3. Determining the content of a course of instruction.
4. Planning the unit operations of a course of instruction.
5. Methods of instruction for a particular unit operation.
6. The determination of a standard of proficiency.
7. The preparation of a proficiency test—A performance test.
8. The preparation of a proficiency test—An information test.
9. The determination of a passing score on a proficiency test.
10. Determining what subjects should be taught in troop and post schools.
11. Selection of enlisted men to be trained as instructors at special service schools.
12. Determining the results of instruction in a series of C. M. T. C. camps.

"*Information topics:*

1. Objectives of Army training.
2. The preparation of an Information Test.
3. The defects of a Free-Answer type test.
4. Preparation of Information Test papers for duplication. Scoring of Information Tests.
5. An analysis of the purpose of the Alpha test.
6. The uses of an intelligence test.
7. List of Training Manuals."

It is somewhat difficult to give the reader of this review an idea of the uniqueness of the manual. Perhaps the educational director of corporation schools, the supervisor of schools generally will find most of it old material. The reviewer doubts it. The reviewer is under the impression that there exists nowhere a manual which contains more that is modern and in advance of practice in educational theory actually put into practice than in this little manual. In itself it constitutes a unit operation, or perhaps several, for the person interested in teaching and in the theory and practice of training.

By this last statement the reviewer intends to say that the educational theory is not expressed in the manual in any formal way. Now and then a simple statement of fact or of viewpoint indicates that the authors are working out a plan that is intended to embody all that is modern in educational research and is offering it to the army. From time to time quotations indicate that there is an attempt to cause army folk to realize that educational research has something to offer them. Contrariwise, this manual has a great deal to offer those who in industry and business are attempting to build courses of instruction, to train supervisors and to measure the results of their efforts at instruction.

If the Adjutant General's Office permits the distribution of the Manual, which is not indicated in the Manual itself, we most assuredly recommend it to all interested in training programs, in the words of the Manual itself: "the officer in charge of a class in this Manual can promote mastery of the information contained therein and ability to use that information in supervised practice teaching by: a. First mastering the Basic Text himself."

WOMEN AND LEISURE

By Lorine Pruette, Ph.D. New York: E. P. Dutton & Company, 1924, pp. xxxiv + 225

Reviewed by Grace E. Manson

Dr. Pruette is of the opinion that women have too much leisure and too little wisdom in its use. She is also of the opinion that "women now on part-time jobs in the home, are dissatisfied, and, at least until they grow soft from too much leisure, want something more to do." More combinations of part-time jobs at home and "interesting

jobs" not at home are being made. The major section of the book takes account of many of these combinations and the attitude of both men and women toward them.

The preface is written by Harry Elmer Barnes. The book proper consists of ten chapters and an appendix. The first two chapters are introductory and largely historical. Chapter 1 emphasizes the, do we dare say, instructive impulse to be active, and the equally fundamental impulse towards self-expression. Modern organization of the home does not give full vent or at least a satisfying vent to these impulses. There is a great wastage of time, products and happiness. Chapter 2 considers woman's place in the division of social labor. "There is needed a readjustment within the division of social labor, a new allocation of functions, which time will doubtless help to bring, so that each may share in the burdens, in the rewards, in the dangers and the blessings of the various activities upon which the life of society depends."

Chapter 3. Women in the Division of Social Labor becomes more quantitative and experimental in tone. Occupational frequencies as gained from census reports are given. "But in spite of the great loss in the past ten years the largest class of women workers is still to be found in domestic and personal service." Chapter 4 continues the discussion of Chapter 3, showing in more detail the occupations in which women are engaged and the occupational trends during the past decade.

Chapter 5. Dr. Pruette discusses the problem of the women who work for nothing gradually leading up to the problem of the part-time worker who obtains some money compensation. "The woman who has been engaged upon the simple drudgery of housework, with its comparative quiet and isolation, may find herself revivified by a few hours of work in a factory, store or office."

Chapter 6 is an experimental answer to the question "Shall the married woman work?" The answer comes from three hundred men who were applying for work at a commercial employment office. The replies on a percentage basis were as follows:

1. The married woman should devote her time to the home.....11.2

2. The married woman should work outside if she desires, except when the care of young children demands her time.....57.6

3. It should be expected that the married women shall earn part of the family income, the husband assisting her with household duties and the care of the children....27.7

4. Housework and the care of children should be be done by specialists or "coöperative methods, the time of the married woman thus set free like her husband's to be used in outside work.....3.5

Dr. Pruette classifies these replies as apathetic, conservative, liberal, and radical.

In the next chapter, 7, the author studies by means of a questionnaire, the activity desires of a group of girls. The group consisted of 347 girls representative of the state of Tennessee. The questionnaire includes such questions as, "If you could choose anything in the world, what would you like most to be? The votes showed that 61 per cent preferred careers, 39 per cent homes. More girls chose to be a wife than to be any other single thing. The second question was, "Why do you want this?" Question 3, "If you had to choose, which would you rather have (*a*) a career, (*b*) a home? 118 girls accepted the career, 212 the home. The other items in the questionnair are equally interesting.

Chapter 8 is given over to a consideration of the day-dreams of the adolescent girl. The material is gained from question 7 on the previous questionnaire. The day-dreams classified themselves roughly as follows, success, 82; romance, 67; popularity 12; travel, 10; altruism, 9; others, 7.

"In the earlier questions we found a considerable vacillation of desires between home and career. Now in the day-dreams, it becomes clear that the seeming vacillation of the earlier questions is not due to inconsistency of desire, but to the presence in the girl's life of two elements, both of which demand consideration, and both of which, it should be noted, in the dream life secure consideration. An apparent inconsistency of desires, or fluctuation between desires, is compelled by the industrial and social con-

ditions of the day. No such inconsistency is demanded of the man who expects both an active life outside the home and a satisfactory home life as well. He has been trained to consider the activity as the necessary basis for the home and to accept the whole burden for maintaining that home. With the same fundamental desires, the same vital urge, the one appears because of social traditions and industrial exigencies inconsistent, the other consistent." This paragraph just quoted we believe to be a fair statement of Dr. Pruette's main thesis. The results of the questionnaire method and the census figures have been her experimental support. Since she states in her preface that her prejudices are the same both before and after writing, the reader can not help but feel that her experimental results are illustrative material rather than conclusions arrived at scientifically. It is worth while, however, to have quantitative data used on such problems rather than opinion and prejudices alone.

The book is well written and interesting. The author's prejudices are in harmony with the modern feminist movement. The home and the work in the home is certainly dragged down from any sentimental pedestal. In fact, the "drudgery" of house work is frequently referred to. The reviewer can not help but feel that the criterion of drudgery is more in the attitude of the worker than in the job. And as for usefulness of the work, criteria other than material productiveness or intricacy of the task have to be taken into consideration. The greatest happiness of all persons concerned has to take its place in the ultimate judgment, regardless of sex, or type of work.

But then, I suppose, I am apathetic, for I am not at all convinced that "many women can attend to their part-time jobs of feeding and populating the world, and still find time for an *interesting* job." Nor, again, am I convinced that work in the home lies outside of the demand, "That work, to be of greatest value to the individual performing it, must have an end and an object, the achievement of which brings a sense of satisfaction, of personal accomplishment and of personal value."

Abstracts

Some Tendencies of Employers' Organizations in 1923. International Labor Review, February, 1924, Vol. 9, No. 2.

Describes and discusses tendencies and trends of various employment organizations throughout the world during twelve months ending in the autumn of 1923. In the majority of countries business was in a period of depression. There were, in general, considerable unemployment, few industrial disputes, and declining standards of working conditions.

During the depression the organizations in general strove to reduce costs. Where business revived increase of output was the dominant thought of these organizations. These are the governing motives that are distinguished throughout the article.

The three main methods for reducing costs are to reduce wages, extend hours, or increase efficiency. The first and most generally adopted plan was to reduce wages. The objections to this plan are that a drop in efficiency and a reduction of purchasing power result, thus defeating the very objects sought. In countries with industries coming out of the stage of depression, employers' organizations increased the hours of work on the ground that stocks must be increased in the face of the growing demand. Scarcity of labor in certain countries supplied some employers with an additional reason for increasing the hours of labor. Thus a combination of the above causes brought about a widespread movement in opposition to existing regulations on working hours.

However, as industrial activity increases, labor forces the pendulum the other way and hours are reduced or wages are increased. The iron and steel industry in the United States is a good example of this state of affairs.

Another contention of employers' associations against regulation of hours of work is that there are no provisions for adjusting the new regime for the requirements of each particular case. The National Association of Manufacturers (United States) considers that "the hours of labor should be so considered as not to cause cumulative fatigue." The Danish Federation leaves its affiliated organizations free to make their own arrangements as to hours. Suggestions have been made that exemptions be more liberal, that a clearer distinction be made between hours of work and mere attention, that lost time be made up, etc. Seasonal industries are especially opposed to regulation of hours of work. The building and contracting industry is particularly insistent in demanding a more elastic form of regulation.

Wage adjustments in the different countries are made on the basis of cost of living, what industry can bear, payment by results, or special "family allowances." Employers generally favor payment by results or other plans framed with an eye to the economic aspect of production as tending to cause less unemployment. The type of wage adjustment varies according to the particular difficulties each country is facing, such as competition, emigration of skilled workers, and depreciated currency. Spanish and Australian associations advocate the living wage idea and the Spanish Employers' Association has advocated the establishment of minimum wage rates. The Australian employers, however, opposed the claim of women workers for equal pay because it would accentuate the injustice to male workers with families.

The most preferable plan for reducing costs is by increasing efficiency. The work of the International Chamber of Commerce in this connection is especially noteworthy.

The Czecho-Slovak Republic and the United States have also done good work in standardization and the elimination of waste in industry. In the United States the Steel Corporation has been getting greater production with 10 per cent fewer men than in 1920. In the United States, also, efforts are being made to educate the public and the workers in the business cycle.

All the above are also of prime importance in reducing unemployment. Other methods of reducing unemployment advocated by employers' associations are to economize on sources of expense not giving a direct productive return, and to secure a reduction of taxation. Employers in Great Britain recently advocated a change in monetary policy in order to restore trade. The report of the Federation of British Industries contends that a revival in industrial activity will bring with it a rise in the price level, and that this rise should be brought about by monetary means. In general, employers' organizations do not approve of relief of unemployment by means other than stimulating trade. The proposal to defer certain types of work until times of unemployment has found very much favor. Practically every phase of unemployment insurance is a debatable subject in one or more countries. There are differences as to whether it should be compulsory, as to regulation, as to the benefits to be paid and the division of cost, and whether it should be by separate industries or by a whole industry. In this regard the Chicago Federation of Clothing Manufacturers has just concluded an agreement with the Amalgamated for an unemployment fund based on equal contributions of worker and employer.

Emigration has also received some support from employers as one method of coping with unemployment. However, unanimous support is given to the idea of immigration to relieve a labor shortage. In Great Britain, immigration and emigration fall in with each other as a means of coöperation with the Dominions. In the United States, attacks on the immigration regulations have been the most prominent activity of employers during the year. In France, employers' organizations are taking an active part in the arrangements for introducing foreign workers. Special efforts are being made to recruit workers from other countries.

The British building trades have declared against dual control of apprenticeship, and in France also the employers think they should have sole control of apprenticeship. In regard to profit sharing, employers generally are opposed to compulsion and wish to regard each case on its merits. The French are in favor of social insurance with particular emphasis on health insurance, while the Italians are opposed to health insurance. There has been a large increase in the number of employers' organizations, particularly in France, Rumania, and Denmark. Several existing organizations have branched out into welfare, efficiency, educational, and research work. There is a general prevelance of strike insurance in the Scandinavian Countries. In practically all countries employers' associations oppose government control or nationalization although they are willing to work with the government in standardization and waste prevention. While employers denounce union production restrictions, and claim unions are attempting the impossible, they appreciate the work of the International Labor Organization. However, the Employers' Group of the International Labor Conference warned that the same standards and conditions of labor and work cannot be applied to all countries, and to apply them to some of the less fortunate countries would penalize them and cause widespread unemployment.

The Racial Origin of Almshouse Paupers in the United States. RAYMOND PEARL. Science, October 31, 1924, Vol. 40, No. 1557, pp. 394-397.

Presents statistics on population of public almshouses, classified as to race and nativity. In 1923, 92.6 per cent of inmates were white, 7.1 per cent were negroes. Negroes constitute 9.9 per cent of total population of country. Social indictment of the negro race in respect to pauperism is difficult to maintain.

On January 1, 1923, 66.4 per cent of

white inmates were native-born, 32.6 per cent foreign born. Corresponding figures, January 1, 1910 show native-born 56.9 per cent, foreign-born 42.6 per cent, or increase of 4000 native-born inmates and decrease of 10,000 foreign-born inmates.

January 1, 1923, there were 59.8 native born white persons in almshouses for each 100,000 of same class of population, compared with 173.6 foreign-born. Corresponding figures in 1910 show native-born 65.0, foreign-born 249.3

Immigrants from Austria, Mexico, Poland, Russia, and Italy contributed proportionately less to almshouse pauperism in 1923 than any other group of foreign-born people in the country.

Data illustrated in table and charts.

Psychology in Economic Theory. A. J. Snow. Journal of Political Economy, August, 1924, Vol. 32, No. 4.

Attempts to show the fallacy of forcing economic theory into the mold of classical psychology. The author believes economists show a lack of proper appreciation of the present state of psychological theory by so doing.

Three main criticisms are prescribed:

a. The economists disregard the "total situation" when they explain certain types of organic activity, and they neglect to take into account the organic state of the animal at the instant of its reaction.

b. They disregard certain forms of modern psychology by the use of metaphysical categories, such as "forces," "impulses," "instincts," in the attempt to explain "native" behavior.

c. Also by taking psychological concepts not generally established to explain economic theory. In one case an attempt is made to apply the Weber-Fechner law to the realm of feeling, in order to explain the doctrine of diminishing returns—satisfactions.

The author urges the economists to make experimental studies of those types of behavior that interest them.

The Significance of Psychology for the Study of Politics. Charles E. Merriam. American Political Science Review, August, 1924, Vol. 18, No. 3, pp. 469–488.

Reviews some of the earlier relations of psychology to political science as interpreted by Plato, Aristotle, Machiavelli, Hobbes, Rousseau, and the utilitarians.

In more recent times, the need of a development of a new type of political psychology has been felt by many students of politics, including, A. Laurence Lowell, James Bryce, Graham Wallas, and Walter Lippman. In recent years psychology also has undergone rapid and marked changes. It has been transformed from a largely speculative to a largely experimental type of study, or at least is in the way of becoming definitely experimental. One of the newer phases of psychology that has attracted wide attention is mental testing. "Education, citizenship, immigration, democracy—are all vitally affected by some of the conclusions that have been drawn from the work of mental testing, whether rightly or wrongly."

Psychoanalysis and psychiatry likewise have an important bearing upon certain phases of political life and conduct. Another significant field is that of animal behavior and of child study. In the study of the child are found opportunities for the observation of the political attitudes and interests of the later citizen.

Up to the present time it must be conceded that the development of social psychology has left much to be desired. It is deplorable that the use of precise measurement in social psychology has been so largely neglected and that the controlled group has been so little utilized for purposes of experiment.

At what points is there likely to be contact between psychology and political science? It seems probable that mental measurement will be still further developed, to include qualities of disposition, and temperament. The political scientist and the psychologist may readily coöperate at this point, one suggesting the qualities it is desirable to analyze, the other supplying the mechanism for measurement. Closely connected with this work is the study of attitudes of the individual.

Another significant field is the study of political interests. These may be examined with reference to their direction and strength, and also with regard to their

genetics. At what time and under what situations do political interests arise, how are they manifested, and under what situation do they acquire strength and direction?

Two suggestions are made with a view to strengthening the inquiry. One is that patterns of traits, habits, responses, behavior may be traced and in this way political inquiries may be charted out in some detail. In the next place it is possible to set up many forms of correlations between individual groups, group traits or individual group patterns on the one hand and items of sex, race, economic status, education, mobility, physical and mental qualities on the other.

In this work the practical coöperation of students of politics and of psychology may be of the very highest value. "What we are striving to achieve is neither psychology as such, nor biology as such, nor economics as such, nor statistics as such, but the development of scientific method in the observation, measurement, and comparison of political relations."

An Experiment in Teaching Method. EDWARD A. DUDDY. Journal of Political Economy, October, 1924, Vol. 32, No. 5, pp. 582–604.

This experiment, made at the School of Commerce and Administration of the University of Chicago in the spring quarter of 1923, was an effort to conduct a course in such a manner that the powers of initiative, coöperativeness and leadership might be released.

The material of the course, Risk and Risk-Bearing, was divided into five major units, upon each of which it was planned to spend a period of approximately two weeks. Each study unit was elaborated by the addition of study topics which were assigned to small groups of students organized into reading and discussion groups under faculty direction.

Instruction was organized into section and squad instruction. The section instructors were responsible for presentations and organization of course material, for posting reference and reservation of books, for section meetings and for assignment, and grading of oral and written work. The squad instructors were responsible for the meetings with the squads which were held regularly twice a week.

Squads were organized immediately after the first meeting of the section. Each squad chose its leader, who was responsible for the squad for the time that one unit of study was being discussed. The squad was made up of approximately five members, with its student leader. Squad instructors were present at all squad meetings but were expected to "keep their mouths shut."

"In the first four weeks of the course, during which this policy was generally maintained, it was about as difficult for the squad instructor to exercise restraint as for the student squad leader to take the initiative and lead discussion."

After each two weeks period a general examination was held upon the general subject of study during that period. Towards the end of the course the plan was simplified in order to bring the range of discussion within narrower limits. At the end of the course students rated each other and were rated by their squad instructors on intelligence, industry, accuracy, cooperativeness, initiative, moral trustworthiness and leadership ability. A graphic rating scale was used. The tendency was for students to rate themselves higher than their instructors rated them. The author believes that the small group method used under favorable circumstances, has real possibilities. It provides a situation in which the student can demonstrate his capacities for leadership and team work as well as his capacity for industry. He can talk more on a level with his instructor and clash on opinion with other members of his group. The method is exacting upon the instructor, but it gives him a better opportunity to know his students and to exert an influence upon them.

Vocational Selection in a Chocolate Factory. W. R. FOSTER. Journal of the National Institute of Industrial Psychology, October 1924, Vol. 2, No. 4, pp. 159–163.

Describes an investigation into the possibility of vocational selection in a chocolate factory (J. S. Fry and Son's Works at Bristol).

Three kinds of workers are chiefly employed: packers, coverers, and machine-hands. The packers, which consist entirely of girls, were the first group for which definite results were obtained. The first step was the determination of the psychological factors necessary for efficiency in the task. Information from previous time- and motion-studies was found to be of considerable value in formulating the capacities required.

A series of tests was drawn up in order to measure these capacities. These tests were designed to be given to the group, and the group was selected to include good, average, and poor packers. Comparisons were then made of the performances with independent estimates of each girl's ability as a packer.

The correlations were found to be very encouraging and it is believed the tests will be of great practical value in the selection of new workers.

No descriptions of the tests are given, simply the results. An effort was also made to determine the relation of general intelligence to packing ability, but little or no correlation was found. The author expresses the hope of investigating the standards of intelligence in each of the various groups of labor employed in the factory.

The correlation between results of tests and estimates of packing ability are as follows:

TESTS	COEFFICIENTS	PROBABLE ERRORS
Hand and Eye Coördination (Circles)	0.59	±0.07
Speed Test No. 1 (Peg Board)	0.49	±0.09
Speed Test No. 2 (Beads)	0.44	±0.09
Imagery and Visual Memory	0.44	±0.09
Substitution A	0.40	±0.10
Perception of Equal Distances	0.37	±0.11
Memory (Cube-Imitation)	0.26	±0.11

An Experiment in the Validity of Judging Human Ability. A. J. Snow. Journal of Applied Psychology, September 1924, Vol. 8, No. 3, pp. 339-346.

From a group of men answering an advertisement for motor truck salesmen, twelve were selected on the basis of their letter of application. These were interviewed individually by six sales managers and a psychologist and ranked by each judge with reference to their fitness for the position in question.

There is a fair agreement among the judges as to the two best and the two worst candidates. This may be partially due to the extreme heterogeneity of the group. There is great disagreement as to the other candidates.

Tests involving mental alertness correlate with the combined judgment to the extent of 0.12, but omitting one anomalous candidate this correlation is 0.41, indicating that "mental alertness as manifested in dress and behavior of the applicant was a major factor in guiding the opinions of the judges."

The judgments of the psychologist who is not a business man show the same statistical characteristics as the judgments of the sales managers. "The experience of the individual judge—business or otherwise—is of no significance. Any intelligent individual is just as good—or as poor—a judge by interview of potential sales ability as any other man."

A Tip on Managing People. Jay Ream. Journal of Applied Psychology, September 1924, Vol. 8, No. 3, pp. 357-361.

Every man craves recognition and if one asks him for information which he feels competent to give he will usually take pleasure in giving it.

In inaugurating a new policy, it often pays to go to the opposition for advice, seem to appreciate his suggestions and later develop a policy to which his suggestions may bear a resemblance, giving him the credit for it. A newcomer made head of a department in which the previous head is retained may forestall warfare by going to the former head for advice.

One should never fail to pay a well merited compliment.

One Industry's Attitude Toward Selection by Mental Levels. C. MARCUS WIENAND. Journal of Educational Psychology, March, 1924, Vol. 15, No. 3, pp. 180–182.

"A large corporation, finding it necessary to assign certain of its workmen for special training to handle new equipment being installed by that company, made an interesting investigation as to various methods of selecting these men. Since intelligence tests were investigated and considered not feasible, the observation of a company official on the use of mental testing will be of interest to all who are concerned with the use of intelligence tests."

This official stated:

"While it is true that the intelligence tests offer a quick and efficient method of determining superior mental capacity, we could not afford to use it. In actual dollars and cents it would represent a big loss to us in the reaction of our employees. At present, we have a fine spirit of coöperation on the part of our employees. The use of the intelligence tests, however, would wreck the morale of our employees. . . . .

"We soon realize in our school that some could grasp new work much more rapidly than others but it is our intention to drill all thoroughly in the work. In order to achieve our ends, every man completing the instruction must be a thorough master of the new details; hence we are not confronted with a problem of possible failures, but of adjusting instruction so that all can thoroughly master it. We do not expect to receive any students below average intelligence, since the nature of our work so far, requires at least average intelligence."

Since the men were actually divided into four classes in order to secure more individual instruction, the question was asked, "Why could not the men be grouped according to mental ability and each class move forward according to the ability of its members?" The answer given was:

"On the contrary we have gained considerable, by adopting the opposite course. We pair a slow man with a fast one and give all to understand that they must master the work. The result is that the fast man actually coaches the slower man thereby impressing the instruction so much more thoroughly in his own mind."

Army Experiments with Progress and Proficiency Tests. ANDREW T. WYLIE. Educational Record, October, 1924, Vol. 5, No. 4, pp. 254–267.

Discusses briefly the progress and proficiency tests in use at the Army Signal School, located at Camp Alfred Vail, New Jersey. In many respects this school has the same problems of instruction and administration to deal with that any other trade or technical school elsewhere would have. There are, besides, problems of a peculiarly military character.

During the past eighteen months a considerable variety of tests and examinations has been developed and used. These include psychological tests at entrance for the purpose of classification and assignment; a so-called inventory type of test which attempts a kind of mental stock-taking; aptitude tests; instruction tests; and the progress and proficiency tests.

A progress or proficiency test is one which examines a definitely restricted field, such as that determined by a series of Unit Operations, Training Manual, or a set of Minimum Specifications relating to some duty or job. The standard of proficiency is the norm, the exact amount or degree of skill or information found to be necessary. Samples of several proficiency tests are given, one for promotion to Staff Sergeant, by a test in electricity and magnetism, another for "Message Center Specialist." The progress tests differ from the usual examination (1) in that the time of giving a progress test does not depend so much upon the calendar or a notice from the registrar's office as it does upon the actual progress which the student or class is making, (2) the tests are given more systematically, (3) the progress tests are standardized, that is the scores of a large number of men in different classes and organizations have made possible the establishment of norms.

Considerable stress is also put upon performance tests in which a man is asked to do something. One of the interesting

developments in the Signal Corps is a group test in which men must act together, not as individuals, but as a unit. A recent development of this new type of group test is a proficiency test which measures the efficiency of the telephone sections of a Field Artillery detail.

Another use is made of proficiency tests in determining the relative merits of two methods of instruction. Just at present an experiment is being carried on at the Signal School to determine whether men learn to send and receive radio messages in code better when taught by a teacher using the usual methods or when taught by machines, the phonograph and the Ediphone. Present indications are that better results are obtained by use of the machines.

Other possible uses for proficiency tests are outlined.

Developments in the Field of Mental Testing. HELEN H. DOLAR. Public Health Reports, October 3, 1924, Vol. 39, No. 40, pp. 2505-2552.

The origin and principles of testing, beginning with a review of the Binet-Simon test. Considers the development and value of the Army tests. With the conclusion of the war in 1918, psychologists turned their attention to developing the field of mental testing. New tests, based on those given in the Army were devised and given to school children. Parallel to this development was the opening of the field of research in industrial psychology and the organization of tests for determining trade ability. The newest field is the effort to measure what are known as temperamental traits.

Interest in the movement is neither as keen nor as extensive in foreign countries as in the United States.

The article includes a bibliography.

Voluntary Motor Ability of the World's Champion Typists. WILLIAM F. BOOK. Journal of Applied Psychology, September, 1924, Vol. 8, No. 3, pp. 283-308.

Four types of motor control were recorded for each arm and hand: (1) rate of moving the forefinger with the hand and arm held in a definite and uniform way; (2) rate of moving the hand, using the wrist as a hinge; (3) rate and regularity of moving the forearm from the elbow joint; (4) rate of moving the upper arm, using the muscles of the shoulder and upper arm.

These tests were given to forty-eight contestants in the international typewriting contest, to five ex-world champion typists and to sixty-five students of typewriting in a university school of commerce. Age norms were available from previous extensive studies.

The present and past world champions and the other professionals in the contest far exceed the age norms in motor control of all the types tested. The amateurs in the contest outrank the novices. For the world's most expert typists, the superiority to the norm is most marked with elbow and shoulder and with the left hand.

The contest groups are more homogeneous in motor control than unselected individuals. This superior motor control is not simply developed by practice, because beginners in a typewriting class compare favorably with experienced students in this class with respect to motor ability. There is a fair correlation between test scores and grades in a typewriting course.

Other factors such as intelligence probably play a rôle in the work of the successful typist, but "an unusual degree of voluntary motor control is a necessary factor for obtaining the highest level of success in typing and in learning to typewrite."

Sex Differences in Geometric Abilities. FRANK C. TOUTON. Journal of Educational Psychology, April, 1924, Vol. 15, No. 4, pp. 234-247.

Report based upon a critical study of the preferences expressed for certain types of geometric originals by 2800 New York high school pupils, and upon the achievements of these pupils in solving the originals selected.

The findings of the study include the following facts for the selected groups of boys and girls under consideration:

1. Boys show a decidedly stronger preference than girls for the construction exercise.

2. The median boy slightly excels the median girl, or somewhat more than 50 per cent of the boys excel the median girl, in achievement shown in solving each of the originals of the list. This difference is not great or even significant, for the individual differences in each group far outweigh in importance the differences between the medians of the groups.

The Child Guidance Clinic. RALPH P. TRUITT. Educational Research Bulletin of the Los Angeles City Schools, March 31, 1924, Vol. 3, No. 10, p. 1.

Reviews briefly the scope of the work of the Los Angeles Child Guidance Clinic. This clinic, recently established for a year's demonstration work, is one phase of the Program for the Prevention of Delinquency financed by the Commonwealth Fund of New York City. Through the Child Guidance Clinic, medicine, psychiatry, psychology, and social case work contribute to the study, training, and treatment of problem children. No phase of child study is isolated. Each part goes to make up a complete picture of the individual child and his adjustments to life.

The Baltimore Packet Record System. A. O. HECK. Educational Research Bulletin of the Ohio State University, April 2, 1924, Vol. 3, No. 7, pp. 146–147.

J. L. Stenquist, Director of Research for the Baltimore school system, designed this packet system to provide in a single unit a comprehensive, cumulative history of each pupil's school career. It includes Pupil's Record Card, Medical Card, Mental Test Card, and Social Worker's Card. Each card is of a different color and bears its name upon a small tab. These tabs are so arranged that all can be seen at a glance, as the packet is picked up. Data can thus be located quickly. When a child is promoted or transfers, this packet follows him by mail from school to school.

Cumulative records are absolutely necessary in meeting counseling problems. Dr. Stenquist has devised a workable scheme of child-accounting which does not require a vast amount of duplicate recording.

Child Accounting. ARTHUR B. MOEHLMAN. Journal of Educational Research, April, 1924, Vol. 9, No. 4, pp. 293–304.

Deals with present conditions which make better child accounting necessary. Among the conditions enumerated are the following:

1. Enforcement of compulsory school attendance laws. Data secured on any other basis than strict accuracy merely serve to hide conditions.

2. Causes of non-attendance when analyzed show where remedial measures are most needed.

3. Present objectives of education demand the keeping of cumulative individual records which include not merely academic data, but health, social, emotional, vocational, achievement, and mental-test records as well.

4. Need for constant appraisal studies of the child's progress through the school and the adjustment of the curriculum to the individual.

Abstracts of Addresses Delivered at Pasadena Joint Conference on Educational Research and Vocational Guidance. Educational Research Bulletin, Pasadena Public Schools, February-March, 1924, Vol. 2, No. 6–7.

This entire issue of the Pasadena Educational Research Bulletin is given over to abstracts of addresses delivered at the Pasadena Joint Conference on Educational Research and Vocational Guidance held under auspices of Southern California Educational Research Association and Southern California Vocational Guidance Association, February 8 and 9, 1924. Among the personnel problems discussed were the following: (1) The responsibility of the Public Schools for the Prevention of Delinquency; (2) The Boy Problem; (3) Vocational Selection and Vocational Training; and (4) Plan for Educational and Vocational Advice on the Basis of Intelligence.

The Careers of the College Student. DONALD A. LAIRD. Pedagogical Seminary, December, 1923. Vol. 30, No. 4, pp. 347–357.

Discusses a survey of the careers chosen by the freshmen and seniors of the University of Wyoming. It is desirable to know the factors that enter into choosing a career. The modern liberal arts students represent those who have been unable to make a choice of a career.

Of the 187 freshmen who contributed to this report there were 13 who had not decided what they were going to follow. Over two-thirds of the students listed engineering, commerce, law, and teaching. Some of the other occupations listed were farming, writing, and art. Practically all reasons for choice could be construed as future, interest, or service. Of the four main groups, women were represented only in teaching and commerce. Commerce and law were mainly attractive for the future in them. Teaching was attractive because of service. Engineering was about equally divided between future and interest.

Intelligence ratings were available for 142 of the students. The rest of the report is limited to this group. The test used was the Thorndike Intelligence Test for High School Graduates. The raw scores were used without regard to other factors. Students selecting careers because of opportunity for success fall in the same score interval as the entire group. Women selecting careers because of service are above the average of freshmen women in intelligence, while the average for the men is below the average of freshmen men. The group choosing careers because of interest was below the general average.

The test showed that generally women selected careers from idealistic motives three times as frequently as men, a ratio which is exactly reversed in the case of practical reasons. Men selecting careers for practical reasons ranked highest in intelligence, and those selecting careers for idealistic reasons ranked lowest. With women this was reversed.

Data were again gathered from 21 seniors, all at the same school. Seven changed their vocation. One was undecided, although definitely decided when a freshman. Two who were undecided when freshmen reached decisions when seniors. Only 2 of the seniors had idealistic motives, although one-third of the freshmen had such motives. These two had not changed their vocational choice. Six of the freshmen who anticipated teaching did not change their minds, but none majored in teaching, and only two minored in teaching.

The conclusion is reached that the average student does not take his vocation seriously until a senior. This may be the reason for the lack of idealism among the seniors; they must make a living. There is a lack of stability in the ideas of the freshmen. They are more interested in extraneous matters. Some of the men are largely influenced by circumstances.

Labor Productivity and Costs in Certain Building Trades. ETHELBERT STEWART, U. S. Commissioner of Labor Statistics. Monthly Labor Review, November, 1924, Vol. XIX, No. 5.

In the spring of 1923 the United States Bureau of Labor Statistics began an investigation of the efficiency of labor in certain occupations in the building trades. The results were very discouraging and

CITY	AVERAGE RATE OF PAY PER HOUR	NUMBER OF BRICKS LAID, PER DAY OF 8 HOURS	COST OF LAYING 1000 BRICKS
Atlanta, Ga.	$1.05	1,482.4	$6.30
Birmingham, Ala.	1.16	1,928.0	4.82
Chattanooga, Tenn.	1.46	1,808.8	6.85
New Orleans, La.	1.01	1,628.0	5.11
Norfolk, Va.	1.375	1,854.5	6.38
Boston, Mass.	1.25	781.6	12.94
New York, N. Y.	1.76	1,260.8	11.69
Philadelphia, Pa.	1.53	986.4	12.65
Chicago, Ill.	1.57	1,254.5	10.60
Cincinnati, Ohio	1.43	1,052.0	11.47
Cleveland, Ohio	1.50	1,182.4	10.55
Denver, Colo.	1.50	1,699.2	7.58
Detroit, Mich.	1.545	1,232.0	10.44
Indianapolis, Ind.	1.36⅛	765.6	14.47
Minneapolis and St. Paul, Minn.	1.21 1/10	1,545.6	6.84

are only published for what they are worth as representing the pioneer attempt to secure the actual facts in this field of investigation.

Previous to the field work a conference of contractors and construction engineers was called and elaborate questionnaires were devised as a result of this conference. But right at the outset, in the "tryout" city of Atlanta, much of the proposed study had to be abandoned, on account of lack of uniformity of methods of work, types of materials, etc.

In spite of the articles and interviews in newspapers and trade journals about the decreased efficiency of labor over former years the bureau was unable to find a single building contractor, superintendent or foreman who had a record of work done per man hour on any present or former jobs. It was found that the men who come into direct contact with building work have very little interest in the time cost by occupations or trades in the building industry.

The complete detailed tables of results are published, but as bricklaying was the only occupation in which the results were at all satisfactory, the summary of that occupation is all that is given on page 409.

News Notes

SALARY ADMINISTRATION

New York Conference of Office Executive's Division of American Management Association

At the second conference of the Office Executives' Division of the American Management Association, held at the Metropolitan Life Insurance Company Building, New York City, on December 11 and 12, a distinct contribution was made by the committee on Salary Administration. The entire first day of the conference was devoted to their reports. Mr. Harry A. Hopf presided and directed the discussions.

The first paper was by the Chairman of the Committee, Mr. H. B. Bergen, of Henry L. Doherty and Company, who gave a thorough exposition of the foundation principles underlying the administration of salary standardization, such as the principle of equal pay for work carrying the same degree of responsibility; the establishment of maximum and minimum limits for jobs; and systematic consideration of opportunities for promotion.

The four main divisions of the problem of scientific salary administration are, Job Analysis, Job Classification or Grading, Salary Standardization, and Salary Adjustments. The success of a job classification is based primarily on accurate job analyses, the making of which comprises the first step in any scheme of salary standardization.

The technique of job classification was treated under two main divisions: (1) A form of qualitative study which results in the establishment of a simple practical grouping of all jobs regardless of departmental lines. (2) A study which is more or less quantitative in which an attempt is made to grade and classify the various jobs more accurately. The first study involves the inspecting of all the job analyses, the identification and grouping of all typical positions and an establishment of groups or levels of relative importance. The second study covers the working out of refinements in the rough qualitative grouping. This is sometimes accomplished by using rating or grading scales for jobs based upon job analyses. Various factors which are considered important are selected and assigned weights when grading the jobs. In the selection of factors to be graded there are two main classes which may be drawn upon, the first including the factors which indicate the importance of the work to be done, such as experience, education, training and minimum age required; and the second including such personal qualities as accuracy, initiative and neatness. The first group being more objective is more reliable, whereas an intelligent appreciation of the limitations of the second group is essential to its successful use.

Salary Standardization is closely allied to job classification. As soon as the job classification is set up, salaries should be assigned to the job levels with definite minimum and maximum rates and intermediate step-rates. These should be integrated with the present salary situation of the organization. The employees of the organization should next be considered, the salaries of those below the minimum being raised to the minimum for the jobs they are holding or the employees transferred to work falling within their rates of pay. Those above the maximum rates should be transferred, if possible, to work for which their rates of pay correspond.

Under proper salary standards, employees will in most cases enter at the minimum rates and work up to the maximum rates set for their particular class of work. In

general, employees upon their promotion should receive the minimum for the jobs to which they are promoted.

Salary adjustments should normally be made on the anniversary of employment. This gives the opportunity for personal consideration of each case on the part of the supervisor. No adjustments, it was urged, should be made beyond the maximum set for the jobs in question. Employees who have reached the maximum should be frankly told that their promotion depends upon the frequency of openings of higher grade in the organization, and their ability to qualify themselves for the higher positions in competition with others in the organization. The basis for salary increase should be the increased value of the employees as demonstrated by actual performance.

The second paper, by Dr. Forrest A. Kingsbury, University of Chicago, described job grading in a large bank.[1] As the outcome of critical job analyses a job grading scale was formulated. Each job was then graded by assigning proper numerical weight to each of the eleven factors finally selected to compose the scale, namely: (1) complexity of duties, 1 to 3 points; (2) executive responsibility involved, 0 to 6 points; (3) responsibility for money or securities, 0 to 4 points; (4) personal contacts with the public, 0 or 1 point; (5) sex, weighted if man is required, 0 or 1 point; (6) minimum age at which candidates are ordinarily considered for the position, 1 to 10 points; (7) minimum general education necessary, 1 to 5 points; (8) minimum special training necessary, 0 or more points; (9) previous experience demanded, 0 to 7 points; (10) personal qualities considered essential –appearance, vitality, courtesy, perseverance, judgment, adaptability, initiative, directing ability, each in specified degree), 0 to 8 points; (11) minimum degree of general intelligence necessary, 1 to 5 points. The various degrees of each factor were defined for each job in terms as objective as possible. The sum of the units of weight of these eleven factors is the "grade-index" and indicates the relative importance of the job. Graphic comparisons of the importance of jobs with salaries now paid were readily made. The gradings were in many cases used as a basis for correction of the salary scales

Professor Paul Brissenden gave a paper prepared by Mr. W. H. Vickers, of the Consolidated Gas, Electric Light and Power Company, of Baltimore. This paper, A "Method and Device for Wage Standardization and Control," can be found in the Journal of Personnel Research, Volume 2, No. 1, May, 1923, pages 1 to 19, and will not here be considered in detail. The main personnel devices described are:

1. A salary control chart showing the minimum and maximum limits of each position in a department. The employees in each position are indicated by pins placed on the chart showing by the positions in which they are located their present salary.
2. Occupational descriptions.
3. Qualification cards.
4. Graphic ratings.

In his paper "Salary Standardization in a Large Office Organization," Mr. J. E. Raasch, of H. A. Hopf and Company, described the methods used in installing a device of this nature in a large company. He illustrated the plan followed in analyzing jobs and preparing job specifications. Questionnaires were sent to individual workers and also to department heads. When returned, they were carefully studied and separated into what seemed to be typical positions in each department. Tentative job specifications were then prepared and job titles indicative of the work were assigned. The statements of duties were submitted to department heads for review and criticism. The necessary qualifications for each typical position were set forth in final form and definitive job specifications prepared. The next step was to group together all positions of similar character and establish levels or zones of relative importance. The job specifications were studied and classified into grades

[1] Journal of Personnel Research, December, 1922, vol. 1, nos. 8 and 9, pp. 377–383.

according to duties and responsibilities. Then a tentative classification schedule containing a description of the jobs classified in each grade was originated. An index chart was also prepared showing in visual form the distribution of typical jobs by grades throughout the departments. The classification schedule and index chart were submitted to the executives for their criticisms and approval. Lines of promotion were established for each position and indicated on the index chart. Another committee then considered the establishment of correct salary limits for the typical positions as set up, keeping in mind the fundamental principles, such as uniform compensation for similar work. Minimum and maximum rates were assigned progressively to each grade in the classification schedule. A number of intermediate rates providing for increases in pay over a period of years were then indicated. Certain positions of higher rank were not considered in the classification due to the inadvisability of attempting to classify them. As the salary limits were fixed without reference to the actual salaries being paid, it was necessary to make adjustments in pay for various employees who were found to be out of line. Therefore, the salaries of those employees who were below the minimum were raised or the employees were themselves transferred to positions carrying rate limits within which their salaries happened to fall. Those employees whose salaries were above the maximum were transferred as opportunity offered.

It was urged that the Personnel Department should have the responsibility of analyzing and classifying the positions subject to the agreement of the department heads involved. A periodic review of all positions should be made for the purpose of keeping the classification and job specifications up to date.

A most enlightening paper was read by Dr. Marion A. Bills on "A Statistical Study of the Interrelation of Nine Items in Ten Life Insurance Companies." The items studied were: (1) efficiency of operation of the clerical forces; (2) average salary paid by the company; (3) average salary paid by the company for different grades of work; (4) average length of service in the company; (5) average length of service of employees doing different grades of work; (6) size of company; (7) geographical location of the company; (8) per cent of women employed by the company, and (9) age of company. The number of policies handled per clerk was taken as the measure of efficiency because it is comparable from company to company, indicative of the amount of work actually done, and easy to obtain. The relative efficiency of the different companies ranged from 296 to 855 policies handled per clerk.

Dr. Bills pointed out that general principles of organization followed by certain companies had a marked effect upon efficiency in the companies concerned, for instance, the principle of being manned for the heaviest day. Some companies are over-manned nine-tenths of the time and consequently show very poor efficiency ratings.

A classification was set up in all but one of the companies on a uniform basis. Job analyses were made as the result of personal interviews with each individual and then a classification was originated with minimum and maximum salary limits. The classification used runs from A to I. Of these divisions, D, F, H and I represent supervisory work. Charts were presented showing the average salaries and average length of service by grades of work for nine of the ten companies. The supervisory employees showed longer periods of service than the individual workers.

Marked correlations were found to exist in the ten companies between the items of efficiency, length of service and salary. The relationship is: salary to service 77; salary to efficiency 88; and service to efficiency 70. There was also close relationship between salary cost per policy, average salary paid and average length of service. It was surprising to find that little correlation existed between geographical location and salary, length of service and efficiency.

A negative relationship was shown to exist between the per cent of women employed and the salary paid. In other words, those companies which paid high

wages had a low percentage of women and those paying low wages had a high percentage of women. A negative relationship existed likewise between the per cent of of women employed and the efficiency of the companies. The length of service in those companies where the percentage of women was high was lower than in the companies having a smaller percentage of women. The conclusion drawn by Dr. Bills follows: "The idea that efficient women can be hired for a low salary is incorrect. A low salary with corresponding brief length of service means inefficiency whether that salary is paid to men or women."

This paper brought to a close a day of valuable contributions to the study of salary administration. The program of the second day was more varied in scope. It included "Training of Office Employees," by H. M. Jefferson, of the Federal Reserve Bank; "Training of Clerical Workers," by Earl B. Morgan, of the Curtis Publishing Company; "Training of File Clerks," by Ethel Scholfield; "Standardization of Office Equipment," by John Barnaby; "Control of Output," by Wallace Clark; and "The Field of Office Management," by M. B. Folsom, of the Eastman Kodak Company.

W. C. BOWEN.

CLEVELAND CONFERENCE ON EMPLOYEE REPRESENTATION

A most successful meeting of the Production Executives' Division of The American Management Association was held at Hotel Winton, Cleveland, on November 13 and 14, 1924. This meeting was decidedly novel in that no reporters were present, no accounts of the meetings were printed, no persons were present who were not entitled to register as interested representatives of member companies or as individual members, and casual visitors were not encouraged to attend. Admission was by registration ticket only. All these regulations were rigidly enforced with the result that discussion was untrammeled and that speakers were able to be perfectly frank on statements of fact and in expression of opinion.

The first day's program consisted of set papers presenting the employee representation plans of individual plants. The second day was taken up in general discussion under the able leadership of Alfred E. Shipley, Personnel Director, Knox Hat Company, and F. L. Sweetser, Dutchess Manufacturing Company.

In answer to the question "Is Employee Representation Growing?" In 1919 there were 225 Works Councils, in 1924 there were 789 Works Councils. In 1919, 806,585 employees were represented in councils; in 1924, 1,116,000 employees. The use of works councils in small plants (less than 200 employees) has decreased; in all larger plants their use has increased. Of twenty-five companies giving reasons for discontinuing councils, only one reported the plan a total failure; one council failed because members would discuss wage *increases* only. Indications point to the good accomplished in averting strikes and settling differences by frank discussion. Where committees act in a purely advisory capacity, they seem to obtain all the advantages and to avoid some of the disadvantages which have accompanied the legislative types of committee.

Committees have considered all types of questions—wages, working hours, working conditions, group insurance, vacations, holidays, overtime, plant rules, sales policies, and many other subjects. In some cases decisions have been rendered and put into effect; in general, however, recommendations only are made. Quite universally committee meetings are held on company time. Practice varies from separate committees representing men and management to committees containing equal numbers of each. All experience points to harmonious action between capital and labor when opportunity for free discussion has been given. In other words, the shop committee, even when nothing further results, becomes a valuable safety valve for relieving disagreements and reducing complaints.

A few striking quotations from the discussion on the second day bring out the spirit of the conference—

"A representation plan to head off a strike illustrates the wrong time to establish a plan."

"The mechanics of the plan is not the important item. It is necessary to get the confidence of the men."

"Purpose—to promote good labor conditions throughout the country."

"Concerns in which the majority of labor troubles originate are not here represented."

"Essentially a matter of the personality of the man who does the organizing."

"Any employee may sit in council and speak on any subject."

"Put plan into operation on a falling labor market."

"Go the limit or stay out. Not an expedient but a remedy."

"Most important for the employee to know what is in the employer's mind."

"Break down feeling of class consciousness by bringing capital and labor together with common interests."

"Direct personal contact between men and management shows that management are men wanting to do the square thing."

"Usually too much about successes and too little about failures."

"Progress—the extending of a larger share of the good things of life to a larger number of people."

Looking back at this convention, the Plant Executives' Division and the Cleveland Committee can take great satisfaction in reflecting upon its success. The meeting served as an excellent clearing house for ideas and information on this important subject. It has strengthened reliance upon the really strong features of a shop committee system and has shown to those considering such a system as a means of promoting fair and equitable industrial relations some of the ways in which success may be attained and failure avoided. Altogether the meeting may be regarded as an important marker on the path to industrial peace.

F. T. Jones.

SHARING MANAGEMENT WITH THE WORKERS

A partnership plan which gives the employee of an industrial property a share in the management and profits, equal in many respects to that enjoyed by the owners, is suggested for the consideration of industry in a report on "Sharing Management with the Workers," recently issued by the Russell Sage Foundation. The report, a document of 150 pages, is based on an investigation by Ben M. Selekman, a member of the Foundation's staff, of the Partnership Plan of the Dutchess Bleachery, Inc. at Wappingers Falls, New York.

Mr. Selekman found that this partnership plan not only affords representation to employees in determining the conditions of their employment, but admits a representative of the wage-earners in the mill to the Board of Directors, turns over entirely to a board of workmen the administration of the company's houses for employees' families, assigns definite responsibility for shop management to a Board of Managers composed of six officers of the company and of six wage-earners, and provides employees with information concerning the financial condition and conduct of the business.

"The Dutchess Bleachery experience indicates affirmative answers to the much discussed questions: Is it financially safe for a company to permit its wage-earning employees to vote on questions of shop management? Do workers desire to have this share of responsibility? Lacking technical training and experience in administration, is their judgment valuable concerning questions of general policy? Will they have consideration for the interests of stockholders? The further point is made that in this case, when given power to determine policies, the employees did not use it to advance their own wages and decrease working hours regardless of the financial state of the business."

"As managers, the representatives of the operatives have displayed good business judgment," says the report. "Not only have they utilized the machinery of the Partnership Plan to present and adjust grievances, but they have coöperated in the

constructive tasks of running a factory. They have suggested such methods of increasing efficiency as time clocks, foremen's conferences, and mass meetings. Together with representatives of the stockholders, they elected the present manager and superintendent. The whole tenor of their participation has been not 'How much can we get out of the bleachery for ourselves?' but 'What can we do to make this a successful and efficient business enterprise for everyone concerned?'

"The Partnership Plan has revolutionized the attitude of the operatives toward production. All the foremen have perceived a new alertness on this subject among the men. To cut down waste, to make certain that no goods were spoiled in the process of bleaching, to finish the greatest number of yards, meant an increase in profits and a larger net income to each operative. Here was an incentive, direct and personal, such as only proprietors of a business have heretofore experienced.

"There can be no doubt that, in spite of the obstacles yet to be overcome, the Partnership Plan has had a very real success from the point of view of the workers as well as from that of the stockholders. Not only do operatives feel that they have a stake in the success of the business, but the active owners realize that a policy of coöperative management such as obtains in the bleachery does not necessarily mean a decrease of dividends."

The publication of this report reveals that the Russell Sage Foundation has had underway since 1919 a series of investigations covering, in addition to the Partnership Plan of the Dutchess Bleachery, the Rockefeller plan of employes' representation as practiced in the steel mills and coal mines of the Colorado Fuel and Iron Company, the Works Council plan of the United States government arsenal at Rock Island, Ill., and the employment policies of William Filene's Sons Company in their store in Boston.

WELFARE WORK OF UNITED STATES STEEL CORPORATION

In twelve years the United States Steel Corporation has expended over $136,500,000 as reported in Labor World of October 9, 1924, to make working and living conditions better and more comfortable. The summary includes playgrounds, schools, clubs, sanitation, accident prevention, stock subscription plans, and on down to the creation of a permanent pension fund. One item of special interest is the large number of dwellings and boarding-houses constructed and leased to employees—28,453.

FORTY-FIRST ANNUAL REPORT OF THE UNITED STATES CIVIL SERVICE COMMISSION

In its forty-first annual report to the President for the year ended June 30, 1924, the United States Civil Service Commission recommends that the chief coördinator, subject to the Director of the Budget, exercise supervision over all Government employment matters with a view to coördination and standardization of all such activities; that Congress authorize comprehensive personnel statistics to supersede the Official Register, commonly known as the "blue book"; points out that the operation of the retirement act has disclosed the need for changes, particularly in the amount of annuity; and calls attention to recommendations of President Coolidge and other presidents for the classification under the civil-service law of postmasters at first, second, and third class offices, and also the recommendation of President Coolidge that Federal prohibition enforcement officers be brought within the classified service without covering the present membership.

Coördination of employment work

The Commission says that "success has attended the coördination of each phase of governmental activity brought within the jurisdiction of the office of the chief coördinator established by Executive order under the budget and accounting act of 1921. Similar advance in economy and efficiency in the Federal service, it is believed, would be brought about by including personnel administration within the coördination program.

"In each of the industries which have attained the greatest measure of success in reducing turnover, accident rate, and

employment controversies, there is a central personnel office charged with the procurement of qualified personnel and with consideration of all conditions following employment. Each industry has a definite employment policy governing all workers alike, and it does not delegate to individual departments or branches of the industry full control over personnel, except as concerns those matters relating to output or production.

"The Federal service can progress in this same direction by joint study of personnel problems by all the departments and independent establishments through the agency of the chief coördinator, Bureau of the Budget. Although the Executive order of November 8, 1921, gives the chief coördinator supervision, subject to the Director of the Budget, over coördination of routine business activities, including employment, this authority as concerns employment has not yet been exercised. We believe it should be."

Personnel records essential

"A record of employees," says the Commission in the report, "is as necessary to the work of the Commission as an inventory is to a business establishment. Without it the Commission is unable to know whether the requirements of the civil-service act and rules are observed or to know such elementary facts as the numbers employed, the expenditures in salaries, the rates of salaries, and such sociological facts as the relative numbers of each sex. . . . .

"Each department and independent establishment, of which there are nearly thirty, keeps its own record in its own way of its employees. It is not possible with such a diversity of methods of regulating personnel to have an adequate statistical presentation of the entire subject or to fully carry out the merit system. . . . .

"There is a lack of system in keeping the record of deductions made from the salaries of employees under the retirement act. The system needs to be put upon a sounder financial as well as a more equitable basis. As a trustee for the fund, the Government should keep careful accounts of the amounts of individual payments, with interest. Instead, the funds assume the form of a vast lump sum against which annuities are charged, and no record is maintained as such of the actual amounts contributed by each employee, the calculation being made only when he leaves the service. Benefits are thus paid to one group of employees from the contributions made by another group. The data about the employee are often meager and inadequate or requiring to be established by ex parte affidavits. . . . .

"Constantly recurring calls for information respecting the personnel of the Government emphasize the need of complete personnel records with facilities for the preparation of statistics required in the administration of acts of Congress relating to personnel. It is hoped that Congress will give consideration to questions of authority and means for this important work, since failure to publish the Official Register of 1923 makes the need greater than ever.

"No detailed statistics relating to Government personnel have been prepared for 16 years, and those compiled were incomplete. Changes which have occurred since, and especially the large influx of new employees during the war, have made useless many facts drawn from such statistics. The Government should not lack statistical information concerning the more than 550,000 citizens constituting its personnel, with an annual pay roll of approximately $785,000,000. . . . . The civil service retirement act, the classification act, and the employees' compensation act have helped to make the Government employee more than a mere hired man to be employed as cheaply as possible, without expectation of his being interested in the business and to be dropped at will and forgotten. . . . .

"One one-hundredth of 1 per cent of the Government pay roll for one year would be sufficient to establish statistical records to meet all needs. This sum is about $70,000. Only a small fraction of this amount would be needed annually for maintenance."

Needs of the Commission

"Before the World War the Commission was called upon to prepare and hold examinations annually for between 300 and 400 different kinds of positions, whereas since 1920 the number has increased to approximately 1,000. This increased specialization reflects not alone the wide field of governmental activity but also the fact that the Commission has been successful in securing for the Federal service well-qualified employees for the many diversified types of work engaged in by the Government.

"Study, of course, must be given to the duties of each position with a view to ascertaining the particular qualifications necessary to perform them satisfactorily; and the appropriate examinations must be devised. This is a high type of research work and requires special training and sound judgment. It has naturally followed that this broadening of the kinds of personnel needed by the Government has added greatly to the volume and complexity of the Commission's work.

"Another source of added work is found in action by Congress to increase existing activities of the Government or to inaugurate new activities, usually without provision for the Commission's part in furnishing the personnel. . . . .

"The Commission's loss in personnel since the armistice has been disproportionate to the executive civil service as a whole, the percentage of loss being 46.8 per cent and 39.5, respectively. In the same period there have been three major additions to the work, namely, presidential postmaster examinations, administration of the retirement act, and an increase from 400 or 500 to approximately 60,000 military preference claims adjudicated each year.

"The promptness which for a number of years has characterized the rating of all general examinations . . . . is no longer possible. These examinations were formerly rated within one month of examination date, but the loss in personnel has been so great that the rating has gradually fallen behind until now approximately three months elapse before the rating is completed. . . . .

"The needs of the Commission, which is the employment agency of the Federal Government, can be met only by more adequate appropriation for personnel, and any additional funds granted for this purpose will not add to the tax burdens of the Nation, but surely and definitely will help to reduce taxes through the increased efficiency of the employees brought into the service by the Commission's examinations."

COÖPERATIVE BUREAU FOR WOMEN TEACHERS

The Smith College Alumnae Quarterly for February contains an announcement by Emma C. Sebring concerning the activities of the Coöperative Bureau for Women Teachers which recently began operations with headquarters at 2 West 43rd Street, New York.

The Bureau was formally organized January 26, 1924. It is the outgrowth of a need felt for some years by a group of distinguished educators and organizations interested in the advancement of the teaching profession, for a common bureau, intercollegiate in scope, which would make accessible to the schools the personal and professional records of successful teachers whether they were in need of placement or not, and which would also maintain files of the scope of work and teaching opportunities afforded by the schools to teachers ambitious for consistent advancement in their profession. Heads of schools are often unable to obtain from college appointment bureaus adequate information about alumnae who are successfully placed as teachers in satisfactory and settled positions; yet they need such information that they may not be restricted in filling vacancies to choices from among the floating clientele of commercial agencies, which can register only such teachers as seek aid in finding new positions. A "Who's Who" of school teachers accessible to the heads of schools as well as a "What's What" of schools accessible to teachers, must prove of inestimable benefit to the profession by increasing competition among the schools for able workers and by increasing opportunities among teachers for recognition of

merit and for promotion to desirable positions.

The organizations most interested, namely the Private School Teachers Association of New York and Vicinity, and the Head Mistresses Association of the East, after working individually upon this problem for some years, came to the realization that only through coöperative effort could such an undertaking be successfully accomplished. With this realization, a joint committee of the Teachers Association and the Head Mistresses Association took those preliminary steps which finally resulted in the organization meeting of January 26, 1924.

In the spring of that year, President Nielson, of Smith College, an eager advocate of this movement from the days when the Smith Bureau was first organized, as chairman of the Board of Directors of the Bureau announced an annual grant of $5000 for a period of two years from the Carnegie Foundation.

At the annual meeting of the Bureau held on November 1st, 1924, the following members were elected to the Governing Board:

Mr. William Allen Neilson, President of Smith College, *Chairman.*
Miss Virginia C. Gildersleeve, Dean of Barnard College, *Vice Chairman.*
Miss Emma G. Sebring, representing the Head Mistresses Association of the East, *Treasurer.*
Miss Jessie M. Tatlock, Association of Private School Teachers of New York, *Secretary.*
Miss Ellen F. Pendleton, President of Wellesley College.
Miss Zita Thornbury, Director, Appointment Bureau of Vassar College.
Mr. James Sullivan, Commissioner of Secondary Education, State of N. Y.
Miss Mina Kerr, American Association of University Women.
Mrs. Arthur E. Lyman, Head Mistresses Association of the Middle West.
Miss Katharine Burke, Head Mistresses Association of the Pacific Coast.
Miss Sarah Converse, National Association of Principals of Private Schools.
Miss Emma P. Hirth, Bureau of Vocational Information.
Miss Sarah Goodwin, Private Schools Association of Boston.
Miss Martha G. Boyer, Association of Private School Teachers of Philadelphia.
Miss Lucy Mitchell, Association of Private School Teachers of New York.
Miss Emelyn Hartridge, Head Mistresses Association of the East.

The Executive Committee is as follows: Mr. Neilson, Miss Gildersleeve, Miss Sebring, Miss Tatlock, Miss Thornbury, Miss Hirth, and Miss Hartridge. The Bureau has been fortunate in securing the services of Miss Margaret Bell Merrill, of Washington, D. C., as Director of the Bureau.

According to the agenda for the coming year, the placement service, facilitated by the promised coöperation of nine college bureaus, will be but one feature of the work. The Bureau will conduct also a bulletin service of value to its members. Other undertakings are contemplated but these will be developed only after the placement and the bulletin service have been well organized.

INVESTIGATION OF ENGINEERING EDUCATION

The Board of Investigation and Coördination has issued under date of December, 1924, "A Statement of Objectives and Outline of Procedures of the Investigation of Engineering Education" now being conducted by the Society for the Promotion of Engineering Education under a grant by the Carnegie Corporation. This statement is printed in full in the *Journal of Engineering Education* for January, 1925. It goes into greater detail than does the statement by the Director, Mr. W. E. Wickenden, in the JOURNAL OF PERSONNEL RESEARCH for July, 1924. Readers of this journal will be glad to note that among the objectives of the investigation are the following:

III. It is the intention to consider in what ways problems relating to engineering students, graduates and

teachers may be dealt with more effectively:

a. To determine what steps may be taken to insure the entrance of properly qualified students.

It is the purpose to consider how the entrance requirements of engineering colleges and the programs of secondary schools may be mutually adjusted; to consider what selective processes of a non-scholastic type may be used as a valid supplement to scholastic requirements for admission; and to consider what information concerning an engineering career should be provided and what guidance given, both before and after admission, in the choice of educational programs.

b. To determine what measures may be taken to deal more effectively with the problems of eliminations.

It is the purpose to learn at what periods and for what reasons students are eliminated or withdraw from college, to ascertain the fundamental causes of failures; and to determine how cases of impending failures may best be dealt with.

c. To ascertain the methods which may best be used by the colleges to facilitate the obtaining of suitable employment by their graduates and to promote their further development.

It is the purpose to canvas the economic demand for engineering graduates through the cooperation of the industries and professional organizations; to ascertain the types of positions and fields of work which graduates are qualified to fill; and to consider what records, supplementary to the usual scholastic record, are best designed to facilitate the employment of graduates.

d. To indicate how methods of recruiting and developing engineering teaching staffs may be improved.

To these ends it is the purpose to learn from what sources teachers of junior and senior rank are being drawn or may be drawn; to learn what methods are in use for developing younger teachers and how such methods may be made more effective; to determine how adequate contacts of teachers with industry and practice may be afforded; and to examine into the mutual responsibilities of the colleges, the industries and the profession for the development and maintenance of teaching staffs of a high order.

INTERNATIONAL INDUSTRIAL WELFARE CONGRESS

The January number of *Welfare Work*, the journal of the Institute of Industrial Welfare Workers, contains particulars regarding the International Industrial Welfare Congress to be held June 19 to June 27 in Holland at the Grand Hotel, Britannia, Flushing. Among the topics on the program are, Employee Representation, Employment Management, Vocational Selection and Industrial Fatigue Research.